# Practical Perſpective,

*John* OR *Moxon*

# *Perſpective made eaſie.*

Teaching

- By the *Opticks*, How to Delineate all Bodies, Buildings, or Landskips, &c.
- By the *Catoptricks*, How to Delineate confuſed Appearences, ſo as when ſeen in a Mirror or Polliſht Body of any intended ſhape, the reflection ſhall ſhew a Deſigne.
- By the *Dioptricks*, How to draw parts of many Figures into one, when ſeen through a Glaſs or Chriſtal cut into many Faces.

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Uſefull for all *Painters*, *Engravers* *Architects*, &c. and all others that are any waies inclined to Speculatory Ingenuity.

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By Joſeph Moxon *Hydrographer to the Kings moſt Excellent Majeſty.*

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# Practical Perspective:

To the Worſhipfull
*WILLIAM ROPER* Eſq.

Sir,

I *Preſent you with this peece of* Practical Perſpective: *Not that I think you unskilfull in this Science, for I know your affections to Mathematical Arts are great, and your perfections therein greater than to learn any thing from me. But as you are a general incourager of ingenuous Studies, and have expreſt a particular reſpect to me by your many Civilities, I alwaies reckoned my ſelf bound to an humble acknowledgement; which Sir, if you will accept this as a token of, it will yet more oblige me to be*

*Sir,*

*Your moſt humble ſervant:*

Joſeph Moxon.

# To the Reader.

AMong the ingenuous Sciences practiſed in this Nation Perſpective ought not in right to have the leaſt eſteem; For that it is full of moſt raviſhing Speculations I think none that knows what it is will deny. But that it is moſt abſolutely neceſſary for all Painters, Engravers, Architects and others that have occaſion to draw Drafts &c. all muſt confeſs: For indeed without it the Painter can neither paint Landskips, Houſes or other Figures proportionable and true, or the Architect deſigne any more than an Orthographick Structure on his Ground-plot. But on the contrary, If an Artiſt works by the Rules of Perſpective, he may paint a remote peece with many Figures in it, and give every Figure its true place and ſize, and ſo ſhadow his work that ſhall ſeem more like the thing it repreſents than a repreſentation of the thing: And the Architect may draw on his Ground plot the appearance of ſeveral ſides of his Building, and place on them either doors, windows, Balconies, &c. each in its proper ſhape and ſcituation.

Since therefore it is both neceſſary and delightfull, I have for the accomodation of Engliſh Artiſts taken the pains to write this following diſcourſe of Practical Perſpective: And I was the rather induced hereunto, becauſe as yet nothing of this nature hath been publiſhed in Engliſh except Sebaſtian Serlio, who though he where a man of skill and fame, yet his book being originally written in Italian, was firſt tranſlated into Dutch, and afterwards from Dutch into Engliſh: One of which tranſlators (if not both) doubtleſs underſtood the language better than the Art; for therein (as the generallity of Ingenuous Artiſts do with me confeſs) the words are tranſlated, but not the Science.

In this work to ſave my ſelf the trouble of making all new deſignes I have collected from ſeveral Authors ſuch Figures as I found moſt uſefull for the Inſtructions of a

*learner, as from* Albert Durer, Neceron, Jean Cosin, Desargues, *but the generallity from* Hondius, *who had them as himself saies (and you may see) from* Marolois.

*Such hath been my care in writing these Instructions, that I dare promise thee they are all true: Such my curiosity in chusing the Terms that some good Authors, and able Artists as well as my self have thought them most significant. And such my desire that thou shouldst learn by this Book, that all along in it I have observed my wonted plainness, so that by it (as I say in the Title) is* Perspective made easie.

*Farewell.*

Joseph Moxon.

# CHAPTER. I.

## *Containing the Definition of* Perſpective, *and its* Species.

OPTICK in Greek is PERSPECTIVE in Latin; and both words (according to Grammarians) ſignifie in Engliſh *Seeing*, or *Sight*.

But the *Opticks*, or *Perſpective*, (which as you ſee is all one) hath yet a more ſublime ſignification than barely Seeing, or Sight, (that being common to all ſenſative Creatures,) For

### *DEFINITION* I.

*Perſpective* is a Mathematical Science, that Speculates, and Contemplates, the manner and properties of all Radiations, Direct, Reflected, and Broken.

### *DEFINITION* II.

By Direct Radiations is meant that branch of Perſpective or Opticks, wherein is conſidered the Direct or Straight beam that paſſes between the Ey and the Object. This Specie of Perſpective is many times (alone) called the Opticks.

### *DEFINITION* III.

By *Reflect Radiations*, is meant the Art *Catoptrick*, wherein is conſidered the Reflection of Beams, and their ſhape upon any Polliſht Body; as a Globe, a Cone, a Cilinder, a Piramid, &c.

## DEFINITION IIII.

By *Broken Radiations.* Is meant the Art *Dioptrick*, wherein is conſidered the breaking of beams as they be ſeen through a Glaſs or Chriſtal cut into ſeveral Plains, or Faces.

This Art or Science is by curious wits brought into *Theory* and *Practice.* The Theory is defined as aforeſaid. And

## DEFINITION V.

The Practice I may define to be an Art Manual, whereby the Theory is reduced to Act. This Manual Art is compounded of *Ichnographie*, *Orthographie*, and *Scenographie.*

## DEFINITION VI.

*Ichnographie* is the Baſe or Bottom whereon any Body or Building is erected. And therefore the Office of Ichnographie is to deſcribe the Bottom or Baſe of any Body, or Building.

There be two ſorts of Ichnographies named in this Book, viz. the *Geometrick Ichnographie*, and the *Scenographick Ichnographie.*

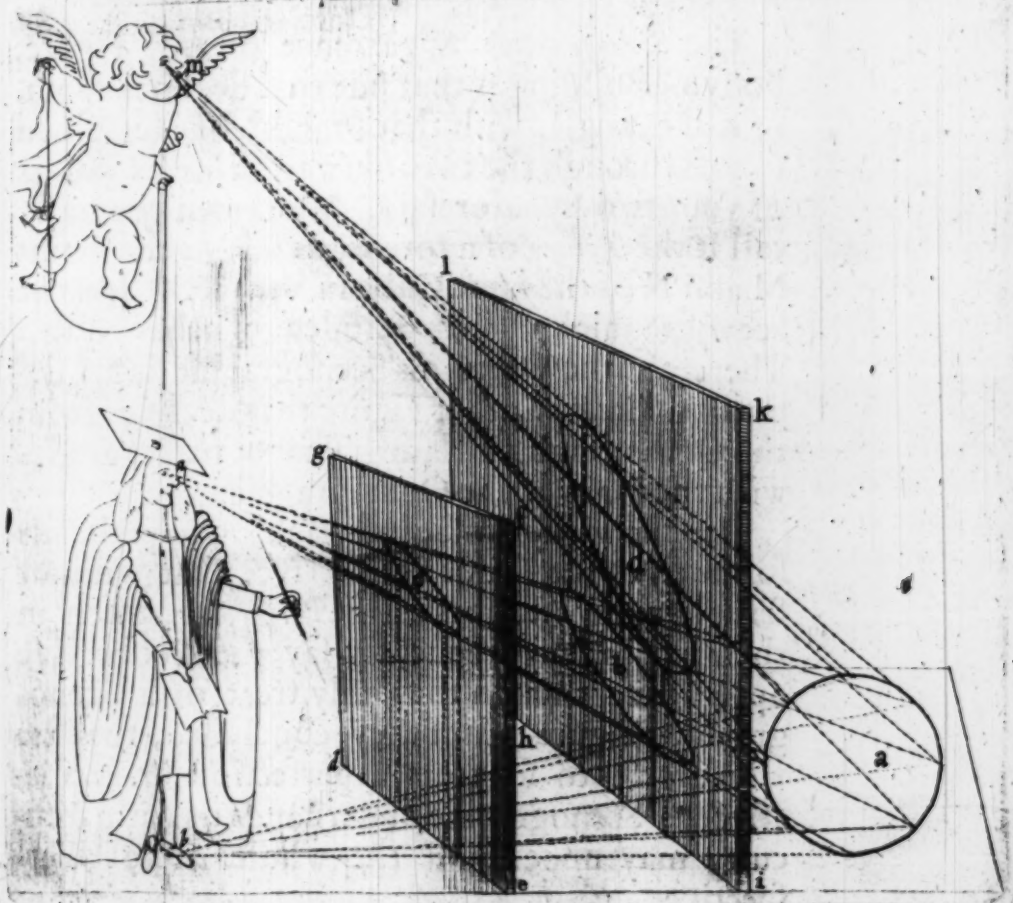
## DEFINITION VII.

By the *Geometrick Ichnographie* is meant the true Geometrick Bottom or Baſe of any Body or Building; as a Circle is the Baſe of a Column, and a Square of four equal ſides is the Baſe of a Pedeſtal &c. This Geometrick Ichnographie is not ſeen in Section, or through a Glaſs, unleſs it be a Glaſs that lies parallel to the Baſe, and therefore makes no Section with it. But

DEFINIT.

## DEFINITION VIII.

The *Scenographick Ichnographie* is the appearence of the ſame Baſe in Section, or through a Glaſs erected perpendicularly on the Plain whereon it ſtands: As allowing the Circle a to be the Geometrick Ichnographie of a Column, the Scenographick Circles b c d ſhall be the Shortned Ichnographies of the ſame Column.




## DEFINITION IX.

The *Orthographie* of any Body or Building, is the fore-right ſide of any Plain. That is, The

ſide or Plain that lies parallel to a ſtraight line that may be imagined to paſs through the outward convex points of your two Eys, continued to a convenient length. As the Plain of the Cube in *Oper.* XIX. marked L is the Orthographick Plain of that Cube. Therefore the Office of Orthographie is to Delineate the fore-right Plain.

## *DEFINITION X.*

The *Scenographick* Appearence of any Figure, Body, or Building, is that ſide that declines from, or makes angles with that ſtraight line imagined to paſs through the two outward convex points of your two Eys aforeſaid. Workmen generally call it the *Return* of a fore-right ſide. As the Plains M and N of the ſame Cube in *Oper.* XIX. are the Scenographick Plains or ſides of that Cube. Therefore the Office of Scenographie is to deſcribe a Plain, or other Figure that declines from the Orthographick Plain. That is, makes angles with the Plain of the Orthographie.

The knowledge of Scenographie comprehends ſo much of the Art of Perſpective, that without ſcruple many Authors call it *Perſpective*, when in their works they frequently ſay the Perſpective appearence, though they only treat of a Scenographick Figure: As if they concluded, that he who arrives to ſo great a perfection in Perſpective, as Scenographie underſtands or with difficulty may underſtand the whole Art of Perſpective.

The Scenographick Appearence differs from the Orthographick in this; The Orthographick repreſents the ſide of a Body, or Building, as it is ſeen when the Plain of the Glaſs ſtands parallel

to

to that ſide. But Scenographie repreſents the ſide of a Body, or Building, as it ſeems through a Glaſs erected not parallel to that ſide.

Theſe foregoing Definitions ſerve to ſhew you who the Lady Perſpective is, and her fair Handmaids *Ichnographie*, *Orthographie*, and *Scenographie*: who all of them in their ſeveral capacities dreſs her ſo curiouſly, that he who is ever admitted her preſence, ſhall ſee a Perſon beautifull enough to commit a rape upon his Ey. But ſhe has a Language by her ſelf, which is one reaſon ſhe is no better underſtood; yet it is very eaſie to learn, and to make it appear ſo, I have compoſed this ſmal Dictionary following,

## CHAPTER. II.

*Containing Definitions uſed in this Art:*

### DEFINITION I.

The *Baſe.* Is the Plain whereon any Object is placed, which for Example ſake we will ſuppoſe to be a huge great plain Field, or if you will but the flat Floor or Pavement of ſome Hall or Chamber. As in *Defin.* VI. of this Chapter, *f g b* is the Plain: This Plain or Floor we ſhall all along hereafter in this Book call the *Baſe.*

### DEFINITION II.

The *Height.* Is the Perpendicular diſtance between the Baſe and the Ey, or which is all one The Height of the Viſual point above the Baſe, becauſe the Ey lies alwaies in the Horizontal line, as well as the Viſual point. Thus the height from

*a* to *b* in the aforeſaid Figure is called the *Height* of the Ey.

## *DEFINITION* III.

The *Viſual Point.* This point is not that point the Ey is placed in, (as moſt young Studients in this Art are apt to think:) But is a point in the Horizontal line wherein all the Occular raies unite. For Example, If you look on a long ſtraight Brick wall, you will perceive the ſeveral laies of Mortar between the ſeveral courſes of Bricks ſeem to incline towards each other, as if they ran into one common Center: Or as if you were in a long ſtraight Gallerey where the two Sides, the Floor, and Ceiling, ſeem to incline and touch each other in a point or common Center, which point reflected on a Glaſs erected perpendicularly on the Baſe, is called the Viſual point. This you may experiment if you lay the Muſcovie Glaſs in *Definition* VI. flat upon the Object a b c d, for then ſo much of your Scenographick Figure as is made of Viſual raies, as the lines *a b* and *c d*, ſhall run into a point oppoſite to the point *e*: which point elevated to the height of the Ey is the Viſual point, as a foreſaid. This point is by ſome Authors called alſo the *Center*: and by others the *Principal Point.*

Note, that where an Object is reflected, it is alſo reverted, as you may ſee in Looking Glaſſes and cleer water. And for this reaſon it is that Orthographick Figures are inverted in their Scenographie. As you may ſee in moſt of the Figures throughout this Book.

## *DEFINITION* IIII.

The *Hozriontal Line.* By the Horizontal line is not

not meant the Baſe or Line of Earth, though in Aſtronomy &c. it is generally ſo taken; But it is a Line proceeding from the Ey, (which in Men of a common ſize is placed about five foot above the Baſe or Ground they ſtand upon,) into the Viſual point, and is Parallel to the Baſe, as the Line *b c* in Chap. 1. *Defin.* 8. is the Horizontal Line.

## DEFINITION V.

The *Diſtance.* The Diſtance is that ſpace on the Baſe contained between the Glaſs and the point in the Baſe that lies directly under the Ey. As from the point *a* in the Baſe, to *o* at the Glaſs is called the Diſtance. Note that in many Figures two points of Diſtance is required, as in *Operation* 10, 15, 16, 17, 18, and ſeveral others throughout this Book.

## DEFINITION VI.

The *Section* Is a Plain of tranſparent matter erected Perpendicularly on the plain of the Baſe, and ſtands directly before you, that is is Parallel to a ſtraight line imagined to paſs through the convex points of your two Eys: As is this Plain of Muſcovie Glaſs erected before the Fi-

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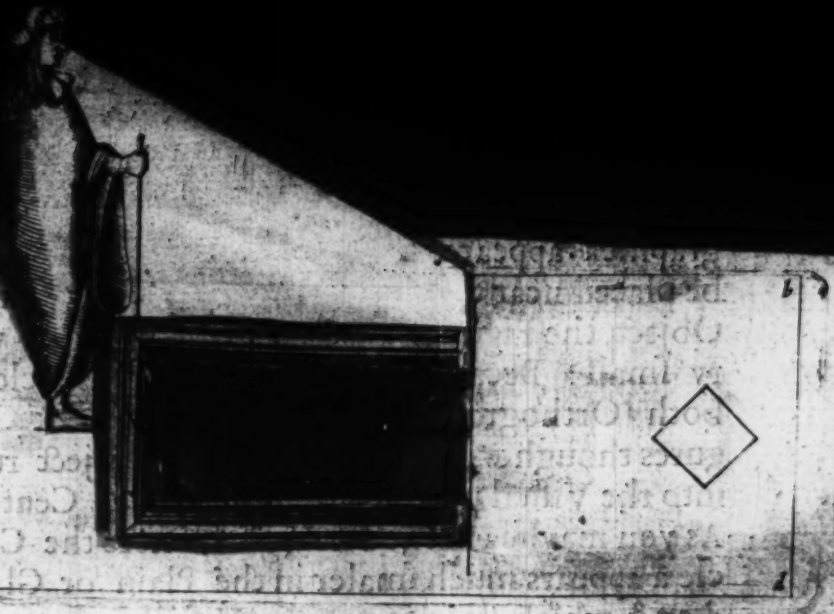

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gure *e*. This Plain is by ſome Authors called the *Section*, by others the *Table*, and by others the *Glaſs*. They that call it a Section call it moſt properly, Becauſe it cuts or interſects the Plain whereon it ſtands, as here it cuts the Plain or Baſe *a b c d*. And they that call it a Table, call it ſo alluſively as they do other Planis whereon any thing is either painted or written. But they that call it a Glaſs have ſome good reaſon for it too, Becauſe we know as yet no other matter ſo apt to demonſtrate the changing of an Orthographick Figure into a Scenographick as Glaſs: And therefore though I confeſs the word Section to be more proper than the word Glaſs, yet becauſe (as I ſaid before) my deſign is Practice: I ſhall all along in this Book (when I have occaſion to name this Plain) call it *Glaſs* and not Section.

This Glaſs or Section is abſolutely neceſſary to be underſtood by all young Students in the Art of Perſpective. Becauſe (as by what hath already been ſaid) without knowing what it is they cannot know what Perſpective means: Neither can they know the reaſon why the Scenographick Figure alters from the Orthographick, or one Scenographick Figure from another. But by rightly underſtanding this Glaſs they may eaſily perceive the Various affections of Scenographick appearences. For firſt, If the Glaſs be placed near the Viſual point and far from the Object, the Figure appearing therein will be very ſmall: Becauſe all the raies which incloſe both Orthographick and Scenographick Figures though wider aſunder at the Object run into the Viſual point as into a common Center: As you may ſee in the firſt Figure, where the Circle a appears much ſmaler in the Plain or Glaſs d e f g, which ſtands neer the Viſual point and farther

farther from the Object than in the Glaſs h i k l, which ſtands farther from the Viſual point and neerer the Object. Secondly, If the Viſual point be placed higher, though at the ſame diſtance from the Object the greater the Scenographick form appears: As you may ſee if you place the Viſual point at m, and delineate the ſame Circle Scenographically as d, it becomes bigger in length and bredth; for the Viſual raies being elevated the ſeveral Perpendiculars erected on the Glaſs interſect them in wider diſtances, Becauſe futher from the Glaſs. As you may ſee in the Scenographick Circle d. Thirdly, If this Glaſs were ſet oblique to the Plain, the Figure would again alter; For if it Incline to the Viſual point the Scenographick appearence of this Circle (for Example,) ſhall on the Glaſs lengthen between the Viſual point and the Object: Becauſe the Plain of the Glaſs gathers in more of the Viſual raies: And if the Glaſs Recline from the Viſual point the Scenographick appearence ſhall grow rounder and more like the Orthographick Figure. But if the Glaſs be placed parallel to the Plain the Object lies on, the Scenographick and Orthographick Figure ſhall appear the ſame; Becauſe the Figure is not ſeen in Section. And all this you may eaſily experiment by erecting the Muſcovy Glaſs in *Defin.* VI. of this Chap. between your Ey and the Figure: For if you keep your Ey ſteddy in one point, and with a black-lead pencil trace about the edges of the ſame Figure as you find it on the Glaſs, you will have the true Scenographie of that Figure: As you may try by comparing it afterwards with the ſame Figure drawn by the Rules of Perſpective, as they are taught in this Book.

## *DEFINITION* VII.

The *Viſual Raies*, or *Diametrals*, are thoſe lines which proceed from the Viſual point through a Glaſs to any point either above or below the Horizon. As in *Oper.* II. the line *c f e* is a Viſual Raie or a Diametral: So is the lines *c k g*, and *c l f* in *Oper.* III.

## *DEFINITION* VIII.

*Lines of Diſtance*, or *Diagonals*, are thoſe Lines that are drawn from the point of Diſtance, to any point either above or below the Horizon. As in *Oper.* III. the line *b k i*, is a line of Diſtance: So is the lines *b d l h*.

## *DEFINITION* IX.

The *Object*. The Object is that Figure, Body, or Building you intend to deſcribe in Perſpective. As in *Oper.* II. the point *d* is the Object: So are the Squares *d e f g*, and *l m n o*, in *Oper.* IIII.

## CHAPTER III.

### *Several Methodical Rules and Obſervations, that may facilitate your Practice in* Perſpective.

1. ALL Lines that in the Object or Geometrick Figure are ſtraight lines, are in Scenographie alſo ſtraight lines.

2. All Lines that in a Geometrick Figure are Perpendiculars, muſt in Scenographie alſo be Perpendiculars.

3. All Lines that in a Geometrick Figure are Paral-

Parallel to its Baſe, muſt in Scenographie be alſo Parallel to the Baſe.

4. All Lines that in Geometrick Figures return at Right Angles from the Orthographick or fore-right ſide, muſt in Scenographick Figures be drawn from the Viſual point.

5. All Right Lines that in a Geometrick Figure return from the Orthographick or fore-right ſide, in a Scenographick Figure run into the Horizontal Line. And

6. All Lines that in the Geometrick Figure are Parallel to that return-line, ſhall in a Scenographick Figure be drawn from that point found in the Horizon.

7. If a Right Angle having one of its ſides againſt the Baſe be to be cut off, ſo as the two ſides of it ſhall remain equal: Then a line drawn from the point of Diſtance ſhall ſo cut it off.

8. If the Figure you deſigne to draw ſtands on your right hand, you muſt place it on the right hand of the Viſual point. If on your left hand, you muſt place it on the left hand of the Viſual point. But if on neither hand, the Viſual point muſt be placed in the middle of it.

9. If you ſet off the Height of Columns, Poſts, or other things, you muſt meaſure the deſigned Height from the Baſe-line upwards in the Front or Orthographie, and a Viſual raie drawn from that point in the Front ſhall ſhew the Height of your Columns, or Poſts, all the way behind the Orthographie, even to the Viſual point. As in *Oper.* XXIX. &c. This is a Rule in all Figures, aſwell wherein there is an Orthographick ſide placed before it, as where there is none.

10. If you are to make Circles, Arches, Croſſes, Croſs-Arches, or any other Figure in the Roof of any Room, you muſt firſt project the ſame on

the Ichnographie; and ſo with Perpendiculars from the eminent points of the ſame, carry it up into the Ceiling: as in *Oper.* 20, 21, 22, 23, 24, 25, 26, 27, &c. And then from thoſe ſeveral points carry on your Circle, or Arch &c. As in *Oper.* 9, 10, 11, 12, 13, 25, 26, &c.

11. If you would find the middle point of any Scenographick Square, Croſs it in the Diagonal Angles with two lines, and in the point where they cut each other is the middle of the Square. As in *Oper.* 17, 20, 21, 22, 23, 24, 25, 26, 27, &c.

12. A Ground Plain of Squares is the ſame above the Horizontal line it is below: Only if it be farther diſtant above or below the Horizon the Squares will be ſo much the wider. As in *Oper.* 20, 21, 22, 23, 24, 25, 26, 27, &c. and all other wherein Roofs, or Ceilings are deſcribed.

*Theſe brief Rules will much help you in your Practice.*

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## *A Caution or two for your more profitable reading this Book.*

YOu muſt take ſpecial notice of the ſeveral ſhapes of Letters wherewith the ſeveral points of each Figure is marked; for in ſome Figures there come ſo many Letters, that I was forc'd to reitterate them: But then the Letters are made in an other ſhape, either in Capitals, as A, B, or ſmal Romian, as a, b: when as otherwiſe they are ſet down in Italick Letters, thus, *a*, *b*. For if you do not take notice that the Letter you ſeek in the Figure be of the ſame ſort with that you read in the *Operation*, you may eaſily miſtake one part of the Figure for another.

Secondly,

Secondly, The different Letters are ſometimes made to ſhew the corroſpondent points of the Geometrick and Scenographick Figures; as in *Oper.* VI. the ſeveral points in the Geometrick Hexagon are marked with Italick Letters, thus, *d e f g h i*, but in the Scenographick Hexagon the reſpondent points are marked with Romain Letters thus d e f g h i.

You are ſometimes directed in this Book to draw a line from the Point *a b c d*, &c. when the point intended is not in the Plate, but lies out of the Plate in the Horizontal line. As in *Oper.* XXXIII. you are directed to draw a line from the point *c*, but it is thereby meant you ſhould draw a line from that point where *c* ſhould ſtand, viz. where the line *d* 13 *c* if continued would cut the Horizontal line, which is the Viſual point; and is in that Figure marked *c*.

Take this advice in Drawing a Perſpective Figure, wherein there comes many Lines: For I have obſerved one main thing that makes Perſpective be thought ſo difficult, is the mixture of many Lines directing to many deſigned points: Therefore when you draw ſome buſie peece in Perſpective, you may for the directing your Ey, Draw the Diagonals in Red, the Viſual Raies in Black, Perpendiculars in Green, or any other different Coullers from that you intend your Perſpective Figure ſhall be of.

There may be ſome more Rules worth your Notice: but as yet not comeing to my memory, Take theſe for the preſent; and as the reſt offer themſelves to me, I ſhall preſent them to you. In the mean time, If you meet with any words of Art you underſtand not, Look over the Leaf, where I have digeſted them in an Alphabetical order, and to them annexed their explanation.

## *An Explanation of such Un-usual words as you may find in this Book.*

*Arch.* A peece of a Circle. As in Oper. 2 *e d* is an Arch of a Circle. *Axis.* is that straight line whereon any Body moves circularly, as in the line *a a* in *Operat.* 21. is the Axis of the Door.

*Base.* See *Chap.* 2 *Defin.* 1 *Broken beams.* See *Chap.* 1 *Defin.* 4.

*Capital.* The top of a Column. *Cateti.es. e f* in *fig.* 22 are Catuti.es. *Catoptrick.* See *Chap.* 1 *Defin.* 3. *Center.* The middle point of a Circle, or any other figure. *Cilinder.* A straight round Body, flat at either end. *Fig.* 53.

*Column.* The upright Pillars markt *x a b y c i* in *fig.* 30. *Composite Order.* an Order in Architect. See *Vignola. Cone. Fig* 54. *Corinthian Order.* An Order in Architect. See *Vignola. Cube.* A Square Body of six equal sides, as I K L in *fig.* 19 are Cubes.

*Diagonals.* See *Chap.* 2 *Defin.* 8. *Diagonal Squares.* The squares in *fig.* 16. are all Diagonal Squares, because all their sides are Diagonal lines. *Diametrial.* See *Chap.* 2 *Defin.* 7. *Dioptrick.* See *Chap.* 1. *Defin.* 4. *Direct beam.* See *Chap.* 1. *Defin.* 2. *Distance.* See *Chap.* 2 *Defin.* 5. *Dorick Order.* An Order in Architect. See *Vignola.*

*Equilateral Triangle.* A Triangle of equal sides, as are the Triangles *d e f* in *fig.* 5.

*Geometrick Figure or Body.* is a Figure or Body that hath its true demensions.

*Ground line.* See *Operat.* 51. *Ground-plain.* A plain full of Squares as *fig.* 15.16.

*Height.* See *Chap.* 2 *Defin.* 2. *Hexagon.* A figure of six equal sides is a Hexagon; as the two figures in *fig.* 6. are Hexagons. *Horizon.* See *Chap.* 2. *Defin.* 4.

*Ichnography.* See *Chap.* 1 *Defin.* 6. *Intersection.* Two lines crossing one another are said to intersect each other. *Ionick Order.* An Order in Architect. See *Vignola.*

*Luminious Body.* Light body, as in *fig.* 51.52.to 56. at *a* is the Luminous body.

*Newel.* is the upright post a pair of winding stairs winde about.

*Object.* See *Chap. Defin.* 9. *Occult.* Occult lines or Arches are dark lines or Arches: which are only drawn for direction to make the Figure up by: these are throughout this book represented by prickt lines and arches. *Octagon.* a Figure of eight equal sides is an Octagon. As are the two Figures in *Fig.* 8. *Opacous body.* A Dark body As in *Fig.* 51. 52. 53. 54. 55. 56. the bodies obstructing beams of Light are Opacous bodies. *Optick.* See *Perspective. Chap.* 1 *Defin.* 1. *Orthography.* See *Chap.* 1 *Defin.* 9.

*Parallel.* Parallel lines are straight lines that are all the way equally distant from one another; as the Base and Horizon throughout this book, are all parallel to to one another. *Parallelepippedon.* is a square body that hath its four sides longer than its two ends, As in *fig.* 56. the square body *f g. Pedestal.* A square body whereon a Column is set, as *d* in *fig.* 28. *Pentagon.* A Figure of five equal sides, as are the two figures in *fig.* 7. *Perpendicular.* A line that falls plumb upon another line, without leaning to one side or another is a Perpendicular line. *Perspective.* See *Chap.* 2 *Defin.* 1. *Pilasters.* Square Pillars that usually stand behind Columns to bear Arches &c.

*Quadrat.* A square figure of four equal sides. *Quadrant.* A figure containing the fourth part of a Circle.

*Radius.* Half the Diameter of a Circle. *Reflected beams.* See *Chap.* 1 *Defin.* 3. *Right Angle.* is made by two lines exactly Perpendicular to one another.

*Scenography.* See *Chap.* 1 *Defin.* 10. *Section.* See *Chap.* 2 *Defin* 6. *Semicircle.* Half a Circle. *Station.* The place you stand on.

*Tetrahedron.* is a Body whose four Plains are four Triangles, as in *fig.* 55. *Tube.* a long hollow instrument wherein is usually a Glass fitted, to observe objects through. *Tuscan Order.* An Order in Architect. See *Vignola.*

*Visual point.* See *Chap.* 2 *Defin.* 3. *Visual raies.* See *Chap.* 2 *Defin.* 7.

## OPERATION. I.

### Height *and* Diſtance *given, To find the ſcituation firſt of a* Point, *ſecondly of a* Line, *and thirdly of a* Square, *in the Glaſſe or Section.*

THe given Height from the ground to the Ey. or which is all one from the Baſe to the Horizon is *a b*, the Diſtance from the Foot to the Glaſſe is *a c*. The given point or Object to be repreſented in the Glaſs or Section is *d*. The Glaſs erected perpendicularly on the Baſe is *e f g h*. Draw a Viſual ray from the Ey at the point *b* to the Object at the point *d*, as *b d*, and another line from the point of Station *a* to the ſame point *d*, as *a d*; then erect a Perpeneicular on the point where this line *a d* cuts the line of Section as at *c*, and where this Perpendicular cuts the Viſual ray *b d* as here it does in *i* is the point that the Object *d* appears in the Glaſs.

*To find the Scituation of a Line in the Section or Glaſs,* You muſt have the Height given, as *a b*, and the Diſtance as *a c*, And as you were taught before to find the place of one point in the Glaſs, ſo now by the ſame Rule the Operation muſt be doubled to find the place of two points in the Glaſs, and then a ſtraight line drawn between thoſe two points is the line required. *Example.*

The given Line is *d e*, Therefore from the Viſual point *b* I draw two ſtraight lines or Viſual rays to the two points at the two ends of the line *d e*, and two other ſtraight lines from the point of Station *a* to the ſame points *d e*, And from the points where theſe two lines interſect the Glaſs (as here they do in the points *c f*) I erect Perpendiculars into the two Viſual raies, and where theſe Perpendiculars interſect the two Viſual raies (as here they do at *g h*) is the points *d e* repreſented in the Glaſs, and a ſtraight line drawn between the points *g* and *h* repreſents in the Glaſs the ſtraight line *d e*.

*To find the ſcituation of a Square figure in the Glaſs.* You have the given Height *a b*, the Diſtance *c*. Draw Viſual rays from the Viſual point *b* to every angle of the Square *d e f g*, and draw alſo lines from the point of Station *a* to every angle of the Square: and where theſe lines of Station cut the line of Section (as here they do in the points *h i k l*) erect Perpendiculars into each reſpective Viſual ray, and where theſe Perpendiculars cut each reſpective Viſual ray (as here in the points *m n o p*) ſhall be each reſpective point of the Square in the Glaſs, and ſtraight lines drawn from point to point ſhall include the Square.

Theſe three Operations (though in effect but one) are ſufficient

to ſhew the nature and quality of the Appearence in Section or Glaſs: but this way is not much uſed among Artiſts; nor is it ſo ready for uſe as laying the Figure along on the Baſe-line drawn Parallel to the Horizon; becauſe this way you muſt draw ſeveral Baſe-lines, even ſo many as you have given points in your Figure; for in this Square you have four Baſe-lines, as the lines *d a*, *e a*, *f a*, *g a*, are all Baſe-lines, which together with the line of Section and the ſeveral Perpendiculars erected on them would ſo peſter a large Deſigne that it would be both tedious to draw and difficult to underſtand when drawn: Therefore I ſhall hereafter in the reſt of this Book leave out the Glaſs thus erected, and ſhew you how to perform the ſame by laying the Figure along on the Baſe.

## OPERATION II.

### Height *and* Diſtance *given, to find the true Scenographick place of a given* Point.

THe given Height is *a b*, the Diſtance given is *b c*, The Point given is *d*. To ſet this Point in its true Scenographick place, Draw a line to repreſent the Baſe, and at the given Height *a b* above it draw a line parallel to the Baſe, to repreſent the Horizon, as *c b*; Then draw a Perpendicular to the Baſe *a a* and Horizon as *b c* into *a* as the line *b a*, and placing one foot of your Compaſſes on the point *a* open the other to the point *d*, and deſcribe the prickt arch *d e*; then lay a ſtraight Ruler to the point of Diſtance *b* and to *e*, and by the ſide of it draw the line *c e* (which we ſhall call a Diagonal line) and where this Diagonal line cuts the Perpendicular *b d a* (as here it does in *f*) is the Scenographick place of the point *d*.

## OPERATION III.

### Height *and* Diſtance *given to deſcribe the Scenographick appearence of a* Line.

THe given Height is *a b*, the given Diſtance is *c b*, the given Line to be delineated in Scenographie is *d e*. Therefore from the given points *d e* let fall Perpendiculars into the Baſe, as *d f* and *e g*, and placing one point of your Compaſſes in *f* open the other to *d*, and ſet off that diſtance on the Baſe, as at *h*, then place one foot of your Compaſſes in *g* and the other to *e*, and ſet off that diſtance alſo on the Baſe, as at *i*; then to the perpendicular points *f* and *g* draw the Diametrals as *c f* and *c g*, and from the transferred Diſtances *h* and *i* draw Diagonals as *b h* and *b i*, and where the Diagonals interſect the Diametrals (as here in *k*

in *k* and *l* ſhall be two points, between which the ſtraight line *kl* being drawn ſhall be the Scenographick appearance of the line *de*.

If you underſtand theſe two Operations rightly, you have already made a good progreſs in Perſpective; for knowing how to place every point and line, you muſt needs know how to draw all Lines Figures and Bodies: Lines being but a progreſſion of points. And all Figures are made of Lines, and all Bodies made of Figures, according to the Definition of Geometers.

Having ſhewed you how to draw a Point and a Line: I come next to Figures, for the drawing of which Scenographically, I ſhall give you this general method, which after (by a little practice) you have made your ſelf familiar with, will ſerve you to draw all manner of Figures.

Having conſidered your Height and Diſtance, and in what Poſition your Figure ſhall ſtand, and drawn it accordingly, either with its Side or Angle againſt the Baſe: Erect Perpendiculars from the ſeveral Angles, or other deſigned points in your Figure into the Baſe, and transfer the length of each Perpendicular from the point where it touches the Baſe, to the Baſe on the ſide contrary to the Point of Diſtance: For then Diametrals drawn to the Perpendiculars in the Baſe, and Diagonals to the ſeveral transferred diſtances ſhall at the interſection with their reſpective Diametrals give the Angles of the Figure. That is, where any Diagonal drawn from any transferred diſtance on the Baſe, ſhall interſect the Diametral drawn from the Perpendicular on the Baſe of that transferred diſtance, ſhall be the point where the Angle ſhall be placed, that repreſents in Scenographie the Angle from whence the Perpendicular was erected on the Geometrick Figure: and lines drawn from point to point, ſhall incloſe the Scenographick Figure.

This is a ſure method and plain; yet becauſe I will make it more eaſie, I ſhall give you ſeveral Examples of this way of working in ſeveral Figures; viz. the Square, a Triangle, a Hexagon, a Pentagon, an Octagon, a Circle, an Oval, and an irregular Figure in ſeveral Poſitions.

## *OPERATION* IIII.

### Height *and* Diſtance *given to deſcribe the* Scenographick *apearance of a* Quadrat, *or* Square, *in two Poſitions; one with its Side againſt the* Baſe, *and the other with an Angle againſt the* Baſe.

THe given height is *a b*, and the diſtance *c b*. Firſt draw the Baſe, and Parallel to it at the given height *a b*, draw the Horizontal line: under the Baſe erect a ſquare Figure, with one

of its sides against the Base, as *d e f g* and transfer the distance of the angles from the Base into the Base, by placing one foot of your Compasses in the angles of the square, at the Base as at *e*, and extend the other to the point *f*, and transfer this perpendicular distance of the point *f* into the Base as at *h*: then remove your Compasses to the point *d*, placing one foot there, and extend the other to the point perpendicularly under it, as to *g*, and transfer that distance also into the Base, as at *e*: Then draw Diametrals from the point *c* to the perpendiculars *e f* and *d g* in the Base, and Diagonals from the transferred distances *f h* and *g e*, and where these Diagonals intersect the Diametrals, as here in *i k*, shall be two angles of the Square, and a line drawn from *k* to *i* shall be one side of the Square, and so much of the Diametral as is comprehended between *k e* is another side of the square: also so much of the Diametral as is contained between *i d* is another side of the square: and the other side of the square lies in the Base, as you may see by the line *d e*.

Here is also laid down a Geometrick Square of four equal sides, having its angle *l* placed against the Base. To describe this in Scenographie, draw lines from the angles *m n o* Perpendicularly up to the Base, as at the points *p q*, and upon these points measure the distance of the angles *m n o* from the Base, and transfer those distances into the Base, as the distance of *p m* fals on *l*, the distance of *l n* fals on *r*, and the distance of *o q* fals at *r*, for Diametrals drawn from the Perpendiculars in the Base, and Diagonals from the transferred distances in the Base, shall intersect each other in the points *s t v l*, which are the four angles of the Scenographick Square: and straight lines drawn from *t* to *v*, from *v* to *l*, from *l* to *s*, and from *s* to *t*, shall include the Square. Where the Diagonal *b r* intersects the Diametral *c q*, is the angle *v*, and a line drawn from *l* to *v* shall represent the side *l o*; where the Diagonal *b r* intersects the Diametral *c l*, is the angle *t*, and a line drawn from *v* to *t* represents the side *o n*: and where the Diagonal *b l* intersects the Diametral *c p* is the angle *s*, and a line drawn from *t* to *s* represents the side *m n*: And lastly a line drawn from *s* to *l* represents the side *m l*, and incloses the Scenographick Square, according to the former height and distance given.

## OPERATION V.

### Height *and* Distance *given, to describe in* Scenographie *the Appearance of two* Equilateral Triangles: *One with one of its* Angles *against the* Base, *and the other with one of its* Sides *against the* Base.

DRaw the Base *a a*, and Parallel to it the Horizontal line *b b*, at the given Height *a b*: place your Visiual point in this line as at *c*, then draw your Triangle (as *d e f*) under the Base with one of its Angles (as *d*) against it, and from the other two Angles erect Perpendiculars up to the Base, as *e g* and *f h*, and transfer the distance of those Perpendiculars from the Base to the Base, by placing one foot of your Compasses first at *g*, and opening the other foot to *e*, and so set off the occult line *e i*; then remove one foot of your Compasses to the point *h*, and extend the other to the point *f*, which distance *h f* transfer also into the Base, as to *k*: Then draw Visual lines from the point *c* to the Perpendiculars *g e* and *h f*, and Diagonal lines from the point *b* (on your right hand) to the transferred distances *i k* in the Base; and where the Diagonal *b i* cuts the Diametral *e g*, as here it does at *l*, shall be the Angle in Scenographie that represents the Angle *e* in the Geometrick Triangle: and where the Diagonal *b k* cuts the Diametral *c h* as here it does in *m*, shall be the Angle in Scenographie that represents the Angle *f* in the Geometrick Triangle. The other Angle in Scenographie lies at the Base, at the Angle *d* of the Geometrick Triangle: therefore a straight line drawn from *d* to *m*, shall be the representative of the side *d f*; and another straight line drawn from *d* to *l*, shall be the representative of the side *d e*, and another straight line drawn from *l* to *m* shall be the representative of the side *e f*.

In the other Triangle with one of its Sides against the Base; you see there is no more to do but to erect a Perpendicular from the Angular point *e* into the Base as *e g*, and transfer that distance into the Base as to *i*, for then by drawing a Diametral from *c* to *g* and a Diagonal from *b* to *i*: you have at the intersection of the Diametral with the Diagonal (as at *h*,) the three Angles of your Scenographick Triangle: *h* represents *e* in the Geometrick Triangle, and *d* and *f* are the same, and straight lines drawn from *h* to *d*, and from *h* to *f*, together with part of the Base *d f* be the Sides of the Scenographick Triangle.

## OPERATION VI.

### Height *and* Distance *given, to describe the* Scenographie *of an* Hexagon *in two positions, one with an* Angle *against the* Base, *the other with a* Side *against the* Base.

DRaw your Base as *a a*, and at your given Height the Horizontal line as *b b*, and in it place your Visual point as at *c*, and points of distance as *b b*, place your Hexagon as *d e f g h i* with one of its Angles under the Base as the Angle *d*: then draw Perpendiculars from each Angle of the Hexagon into the Base as *f e k*, *g d*, and *h i l*, and transfer the distance of each Angle from the Base to the Base, as before in the several operations: for then Diametral lines drawn from the points where the Perpendiculars touch the Base, and Diagonals from the transferred points in the Base shall by their mutual intersection, give the Angles of the Scenographick Hexagon: and straight lines drawn from Angle to Angle shall shew the Figure. The several Angles of the corresponding Figure are markt with Roman Letters as **e f g h i**.

The other Hexagon with one of its sides against the Base, is also made by erecting Perpendiculars from each Angular point in the Figure, and transferring the distance of each Angular point from the Base to the Base, for then Diametrals drawn from the Perpendiculars in the Base, and Diagonals from the transferred distances in the Base shall at the intersection of each Diametral with its respective Diagonal give the Angles of the Figure: That is, where the Diametral drawn from any Perpendicular shall intersect that Diagonal that is drawn from the transferred distance of that Perpendicular shall be the point where the Angle shall be placed that represents in Scenography the Angle from whence the Perpendicular was erected on the Geometrick Figure. As you may see by the corresponding Roman and Italick Letters.

## OPERATION VII.

### *To describe the* Scenographie *of a* Pentagon, *in two several* Positions, *one with a* Side, *another with an* Angle *against the* Base.

DEscribe your Base as *a a*, and Parallel to it at your intended Height as *a b*, describe the Horizontal line as *b b*, and elect your Visual point as at *c*, and on either side as at *b b* your points of

of diſtance; then draw a Geometrical Pentagon with one of its Angles as *d* againſt the Baſe, and from all the reſt of its Angles viz. *e f g b* erect Perpendiculars into the Baſe, which Perpendicular diſtances from the Baſs tranſfer into the Baſe, (as you have in the foregoing *Oper.* already been taught.) Then from the Viſual point *c*, draw Diametrals to the Perpendiculars in the Baſe, and Diagonals from the point of diſtance *b* on your right hand to the ſeveral tranſferred diſtances on the Baſe, and the interſections of theſe Diagonals with the reſpective Diametrals ſhall be the reſpective Angles of the Scenographick Pentagon: And ſtraight lines drawn from Angle to Angle ſhall include the Scenographick Figure.

The other Pentagon with one of its Sides againſt the Baſe, is alſo made by erecting Perpendiculars into the Baſe, and tranſferring the length of each perpendicular from the point where it cuts the Baſe to the Baſe; for then Diametrals drawn to the Perpendiculars in the Baſe, and Diagonals to the ſeveral tranſferred diſtances ſhall at the interſection of each Diagonal with its reſpective Diametral give the Angles of the Figure: That is, where any Diagonal (drawn from any tranſferred diſtance on the Baſe,) ſhall interſect the Diametral drawn from the Perpendicular (on the Baſe,) of that tranſferred diſtance, ſhall be the point where the Angle ſhall be placed that repreſents in Scenographie the Angle from whence the Perpendicular was erected on the Geometrick Figure: and ſtraight lines drawn from Angle to Angle ſhall incloſe the Scenographick Figure. As you may ſee by the correſponding Romain and Italick Letters.

## *OPERATION* VIII.

### Height *and* Diſtance *given, to Deſcribe the* Scenography *of an* Octagon, *with one of its* Angles *againſt the* Baſe: *and another with one of its* Sides *againſt the* Baſe.

THis Operation is alſo performed as the other, viz. by drawing Perpendiculars from the Angles up to the Baſe, and ſetting off the diſtance of the Angles from the Baſe on the Baſe: For then by drawing Diametrals from the Viſual point to the Perpendiculars on the Baſe, and Diagonals from the point of diſtance ſet off on the Baſe, you have in their mutual Interſections given the Angles of the Scenographick Octagon; and ſtraight lines drawn from Angle to Angle ſhall ſhew the Figure. As you may ſee by the correſponding Romain and Itallick Letters.

The other Octagon is alſo made by drawing Perpendiculars from each Angle up to the Baſe: And (as before) tranſfer the Per-

pendicular distances of every Angle from the Base to the Base. Then from the Visual point draw Diametrals to the Perpendiculars in the Base, and from the point of distance Diagonals to every transferred distance on the Base, so shall the mutual intersections of each Diametral, and Diagonal give the Angles of the Octagon, and so much of the Visual raies and lines of distance as are comprehended between every two Angles shall be the several Sides of the whole Figure.

By this *Operation* therefore you may perceive an Octagon with one of its Side against the Base, is readier to be drawn than any other Figure: Because in all other Figures after you have found the several Angles of the Figure, you must draw straight lines from Angle to Angle to represent the Sides: But herein you describe the Angles and Sides all at once. And hereby you may (if you will consider it) apprehend the nature and quality of the three most principal Lines used in Perspective viz. the Parallel or Fore-right Line, the Return Line, and Diagonal Line: For as was said in the *Preface*, those Lines that are Parallel to the Base in a Geometrick Figure, must be Parallel to the Base in the Scenographick Figure: And those Lines that return from the Base right Angularly in the Geometrick Figure, must in the Scenographick Figure be drawn from the Visual point, and Diagonal Lines viz. those lines that cut off a part of the two sides of the Right Angle at equal distance from the Angle in the Geometrick Figure, shall be drawn from the points of distance. Thus you see the Lines *d e* and *i h* in the Geometrick Figure are Parallel to the Horizon: so are their representatives d e and i h in the Scenographick Figure: And thus you see the lines *f g* and *l k* in the Geometrick Figure Perpendiculars, and their representatives f g and l k in Scenographie are drawn from the Visual point. Also thus you see the Diagonal Lines *e f, g h, i k, l d,* in the Geometrick Figure represented by part of the Diagonals e f, g h, i k, l d, in the Scenographick Figure.

## OPERATION IX.

### Height *and* Distance *given, to Describe a* Circle *in* Perspective.

DEscribe first a Geometrick Circle, and divide it into twelve equal parts as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, through each one of which divisions let fall a line Perpendicularly on the Base, as through the point 1, draw the line which also runs through the point 7, through the point 2 which also passes through the point 6: and so for the rest, as you may see in the Figure.

Then from the point 2 to 3 draw a Diagonal Line and continue it into the Base, and from the point 1 to 4 draw another Diagonal Line, which also continue into the Base. So is the Ichnography of your Circle fitted for your purpose.

For

For describing the Scenographie of this Circle, let fall a Perpendicular upon the Base from the Visual point *c*, and from that Perpendicular set off on the Base each way the distance of each Perpendicular from the point 1 in the Geometrick Circle; and to those distances draw Diametrals Lines from the Visual point *c*: then set off on the Base the distances of the several Diagonal Lines from the point 1 in the Geometrick Circle, and to those distances draw Diagonal Lines from the point of distance *b*. And the intersections of those Diagonal Lines with the respective Diametral Lines are the points through which the Scenographie of the Circle is to pass.

Note, That though this Geometrick Circle be placed on the Base, it is all one in effect as if it had been placed under the Base, as the other Geometrick Figures delineated in Perspective are: for the distance of every point from the Base would be the same. In the foregoing Figures you have all the points of the Figures drawn up into the Base by Perpendiculars erected, and in this for want of room to place it under the Base the several points are transferred downwards to the Base from the point 7, on either side the Perpendicular 1 7.

## OPERATION X.

### *Another way to draw the* Perspective *of a* Circle *at any Assigned* Height *and* Distance.

DRaw your Base and Horizon, as hath been taught before: and having assigned your Visual point, and points Distance, Draw on a Center in the Base a Semi-circle; This Semi-circle must be included in half a Quadrat, as in the Figure; and divided into as many equal parts as you please, (the more the better) this Figure is Divided into eight, as *defghiklm*, and through every point of division must be a line drawn Perpendicular to the Base and continued to the outmost verge of the half Quadrat: These several Perpendiculars must be crossed at right Angles with other lines Parallel to the Base, and drawn through those points of division in the Semi-circle that are equidistant to one another: So is your Geometrick Semi-circle finisht. Then from the Visual point draw Diametral lines to the several points where every Perpendicular touches the Base, and also two Diagonal lines from the points of distance *bb* to the points where the Semi-circle touches the Base, so shall the intersections of those two lines with the Visual lines be the points through which you must draw lines above the Base Parallel to the Base (as in *Oper.* XV.) and the intersections of those respective Parallels with the respective Diametral or Visual lines are the points through which the Scenographick Semi-circle is to run, as at **d e f g h i k l m**, which is one half of the Scenographick Ground. The other Scenographick Semi-circle is drawn through the intersections of the Diametrals with the Parallels in the under half of the Scenographick Ground.

## *OPERATION* XI.

### Height *and* Diſtance *given, to Draw the* Perſpective *of a* Flat Oval.

DIvide the Circumference of the Oval into ſo many equal parts as you pleaſe, the more the better; (In this example we have 16,) and mark them with 1 2 3 4 5 &c. from theſe points raiſe Perpendiculars into the Baſe, and transfer the diſtance of each Perpendicular from the Baſe to the Baſe: Then from the point of diſtance *c* draw Diametrals to the ſeveral Perpendiculars in the Baſe, and Diagonals to the transferred diſtances of thoſe Perpendiculars, and the mutual interſections of the Diagonals with the reſpective Diametrals ſhall give the ſeveral points through which the Scenographick Oval muſt paſs: as where the Diagonal drawn to the point 1 on the Baſe cuts the Diametral drawn to the point 1 is one point through which part of the Circumference of the Scenographick Oval muſt be drawn: and where the Diagonal drawn to the point 2 on the Baſe cuts the Diametral drawn to the point 2 is another point through which part of the Circumference of the Scenographick Oval muſt paſs. The like is to be underſtood of all the other Diametral and Diagonal Interſections.

## *OPERATION* XII.

### *To Deſcribe an irregular Figure in* Perſpective, Height *and* Diſtance *given.*

THe Angles of this Figure are *defghiklmno*, which erect Perpendicularly into the Baſe (as before,) and alſo transfer their Perpendicular diſtances from the Baſe into the Baſe, for then Diametrals drawn to the Perpendiculars and Diagonals to the transferred diſtances cut each other reſpectively in the Scenographick points where the Angles of the Figure muſt be placed, and lines drawn from Angle to Angle ſhall include the Figure. As you may ſee by the correſponding Romain and Italick Letters.

## OPERATION XIII.

### *To begirt the former Figure with* Parallel Lines *about it, in* Perſpective: Height *and* Diſtance *given.*

THeſe two Figures are inſerted to ſhew that whether your Figures are regular or irregular, Circumſcribed or not Circumſcribed, the working remains the ſame in all reſpects: For as in the foregoing Figures, ſo in this, Perpendiculars erected from the Angles, and the diſtance of the Angles from the Baſe transferred to the Baſe, and Diametrals drawn to the Perpendiculars in the Baſe, and Diagonals to the transferred diſtances cut each other in thoſe points the Scenographick Angles muſt be placed, from whence lines drawn to each other reſpectively ſhall begirt the former Figure with a line Scenographically Parallel to it.

I have been the more copious upon theſe Figures becauſe they come often in uſe in the deſigning of Ground Plots, whereon to raiſe any Structure in Gardening, and in Fortifications. &c.

## OPERATION XIIII.

### *Shewing that from one Geometrick Figure you may make two or more* Scenographick *Figures by Elevating of the* Horizon.

YOu were taught in *Oper.* VIII. to reduce the Geometrick Octagon *defgbikl* into Scenographie, which is here alſo noted with its correſponding Romain Letters. But you may make yet another appearance of this Figure, if you alter the Height though you obſerve the ſame diſtance, for here the Horizontal line is elevated into the upper *bc*, and Diametrals drawn to the ſame Perpendiculars, and Diagonals to the ſame transferred diſtances, by their mutual interſections give the points *FGHIKL* which are the Angles of the ſecond Octagon, and lines drawn from each Angle to its next ſhall include the Figure.

This way of working may be of great uſe in drawing Covers for Boxes, Covers for Pulpits, and for ſeveral other deſignes, for according to your purpoſe you may either elevate or depreſs the Horizontal line, or make as many elevations as you pleaſe.

## OPERATION XV.

### To Deſcribe the Scenographie of a Plain with Seven Quadrats or Squares in Length, and Seven in Bredth therein: Height and Diſtance given.

THe given Height is *a b*, and the given Diſtance *c b*, draw the Baſe *a a* and Parallel to it at the given Height the Horizontal line *b b*, then ſet off the diſtance with your Compaſſes from the middle of the Horizontal line both waies, as from the Viſual point *c* to *b b*: And keeping one foot of your Compaſſes ſtill in the Viſual point, ſet off your deſigned length of the Baſe as at *a a* on either ſide making ſmal occult arches or markes on the Baſe; then draw two Diagonal lines from the points of diſtance *b b* to the points *a a*, and two Diametrals from the Viſual point *c* to the points *a a*, and where the Diagonals *b a* cut the Diametrals *c a*, as here in the points *d d* and *a a* ſhall be the four Angles of this Scenographick Plain, and a ſtraight line drawn from *d* to *d* ſhall be one ſide of this Plain: The Baſe line *a a* another ſide, and two lines drawn viz. one from *a* to *d* on the right hand, and another from *a* to *d* on the left hand ſhall be the other two ſides that include this Square. Then divide the Baſe into Seven equal parts, as from *a* to *e f g h i k a*; and by laying a Ruler on the Viſual point *c* and each of theſe parts *e f g h i k* draw by the ſide of it Diametral lines through the Plain, and to the points where thoſe Diametral lines interſect the two Diagonal lines *b a* and *b a* (as here they do in 1 2 3 4 5 6 *d*. 1 2 3 4 5 6 *d*) lay a Ruler and draw lines by the ſide of it Parallel to the Baſe, ſo ſhall your work be finiſhed.

## OPERATION. XVI.

### Height and Diſtance given, To Deſcribe the Scenographie of a Plain full of Squares with their Angles pointing againſt the Baſe.

THe given Height is *a b*, the given diſtance *c b*: Draw the Baſe *a a* as before, and at the given Height Parallel to it the Horizontal line as *b b*; then take the middle of the Horizontal line for the Viſual point as at *c*, and ſet off your diſtance as at *b* on either ſide *c*: Then let fall a Perpendicular through the Baſe as *c d*, and from the point *d* divide your Baſe into as many equal parts as you pleaſe both waies (as here into 6 each way marked with 1 2 3 4 5 *a*;) then

Then draw the two Diametrals to the points *a a*, and two Diagonals from the points of Diſtance *b b* to *a a*, and where theſe two Diagonals *a b* cut the Diametrals *c a* (as here in *e e* and *a a*) ſhall be the four angles of the Scenographick Plain; and a ſtraight line drawn from *e* to *e* ſhall be one ſide of the Plain, the Baſe *a a* is another ſide, and part of the Diametrals viz. from *a* to *e* on either ſide ſhall be the two other ſides of this Scenographick Plain. Then laying a ſtraight Ruler to both the points of Diſtance and all the deviſions on the Baſe, Draw lines from thoſe deviſions to the Diagonals, ſo ſhall half your Plain be filled with Squares. To fill the other half, You muſt lay your ſtraight Ruler to the ſeveral interſections of the Diagonals with the two Diametrals on either ſide the Plain, and draw ſtraight lines into the ſide of the Plain *e e*, ſo ſhall the other half of your Plain be filled alſo.

The making of theſe two Scenographick Plains full of Squares is of great uſe in Perſpective, for the ready deſigning and placing all ſorts of Buildings and moveables in their proper diſtances one from another, and in their various appearences to the Ey: For in the deſigning of Stools, Tables, Croſſes, and many other Figures your labour is as much facilitated as by coppying a Picture when it and what you draw on are devided into ſquares, and is indeed vertually the ſame thing. For inſtance, If you deſigne each ſide of one of theſe Squares to be an Inch, a Foot, or a Yard &c. long; then what Object ſoever is placed one Square diſtant from another is ſaid to be either an Inch a Foot or a Yard &c. diſtant: What Object is placed two Squares off is placed two Inches &c. diſtant. And ſo for any number of Squares.

Again, For the various appearence to the Ey. All Buildings or Moveables whoſe fore-ſides are ſcituate in an Orthographick Plain are drawn upon the Squares in Operat. XV. becauſe the fore and back ſides of thoſe Squares ly in an Orthographick line. As you may ſee the Cubes in Operat. XIX. and the Buildings in Operat. XX. XXI. XXII. XXIII. XXIIII. XXV. XXVI. XXVIII. XXIX. XXX. XXXI. XXXVIII. and the Moveables in Operat. XXXIX. But thoſe Buildings or Moveables whoſe corners ly in the Orthographick Plain, that is, whoſe front declines from an Orthographick line are beſt placed on this Scenographick Plain that hath its angles againſt the Baſe. As you may ſee in Operat. XL. XLI. XLII. and XLIX.

In theſe two Plains you may ſee how the ſeveral diſtances of the Object alters its appearence: for all the ſeveral appearences of thoſe Squares are but the ſeveral appearences of the Squares *g h l m* in the laſt Operation, and *d f g h* in this, whoſe points are transferred into the Baſe, and made as in the foregoing Operations.

## *OPERATION* XVII.

### Height *and* Distance *given, to Draw a* Scenographick Ground-plain *in Squares, each Square being begirt with Frame-work.*

DRaw first the Base *a b*, and Parallel to it at the given Height the Horizontal line, in which from your elected Visual point set off your distance as *c d*, then place one foot of your Compasses in the Visual point and extend the other on either side the Base to what width you intend your Geometrick Squares with its Frame-work about it shall be, as to *a* and *b*: Then draw your Geometrick Squares with its Frame-work: but you need not draw the whole Geometrick work in depth; for the Visual point being placed just Perpendicularly over the middle of the Geometrick Draft each half is exactly alike, and therefore one half will serve as well as both. Having drawn your Geometrick Draft, draw first Diametral lines from the Visual point to the points *a* and *b*, which shall be the limits of the length of the Scenographick Ground-plain: Then draw Diagonal lines from the point of distance *d* on either side the Visual point also to the points *a b*; and where those Diagonal lines intersect the Visual or Diametral lines as in *e f*, draw a line Parallel to the Base: and it shall limit the depth of the Scenographick Ground-plain: then draw Diametral lines from the Visual point to every point where each Perpendicular of the Geometrick Figure touches the Base, and if to those points where these several Diametral lines cut the two Diagonal lines you lay a Ruler and draw a line by the side of it those lines will be Parallel to the Base, and shew the true Scenographie of the whole Geometrick Figure.

## *OPERATION* XVIII.

### Height *and* Distance *given, to Draw in* Scenographie *a* Ground-plain *full of Squares, with their* Angles *against the* Base: *each Square being begirt with Frame-work.*

HAving described half the Square *a b c* with the Angle against the Base, draw the Base *d d*, and Horizontal line *e e* as by the last *Oper.* and set off your points of Distance *e e* from the Visual point *f*, then continue the straight lines of your Frame-work *b g*, *c g*, and all the other lines Parallel to them into the Base; and

Diagonal

Diagonal lines drawn from the points of diſtance *e e*, to the points *g h i k a l m n g* ſhall perform your *Operation:* as you may ſee in the Figure.

Theſe two Figures are of great uſe in the Deſigning of Buildings, for placing Columns, Pilaſters, Peers, &c. or for dividing of Houſes, Rooms, &c.

## OPERATION XIX.

### *To deſcribe the Appearance of three* Cubes *in* Perſpective *ſtanding directly forwards on the* Baſe.

DRaw a Ground-plain of ſix Squares as you were taught by *Oper.* XV. Then draw a Geometrick Square ſtanding on the Baſe as 1, whoſe Angles are marked with *a b c d*, and from the points *e f*, erect two Perpendiculars as *e g*, *f h*, then draw Diametrals from the Viſual point *v* to *b* and *c*, and the interſections of thoſe Diametral lines with the Perpendiculars *a b*, *c d*, *e g*, *f h*, ſhall be the points, from whence ſtraight lines drawn (as you may ſee in the Figure) ſhall include the Cube.

The Cube K ſtanding more directly afore the Ey hath another Appearance, yet is the manner of working with Diagonals and Perpendiculars the ſame.

The Cube L being a hollow Cube (or as it were a) Box without a top-cover, ſtands alſo on a Square, as *l o n m*, whereon the Perpendiculars *l l o o n n m m* muſt be erected, and Diametrals drawn from the Viſual point to the interſection of theſe Perpendiculars, ſo ſhall ſtraight lines drawn from theſe interſections (as in the Figure) include the Cube: But the thickneſs of the Boards you muſt ſet off in the bottom of the Cube Parallel to the Baſe as *q p* and *r s*, and make of theſe another Scenographick Square, by drawing Diametral lines *q r p s*, and in the Angles of this ſecond Square erect the four Perpendiculars *q q r r p p s s* and from the Viſual point draw Diametrals to interſect them in the top of the Box as *p q s r*, and ſtraight lines drawn from interſection to interſection ſhall include the thickneſs of the Boards as they appear from the height *v* and diſtance *t*.

## OPERATION XX.

### *To deſcribe the Scenographick appearence of the inſide of a Chamber.*

THis is performed by help of a Ground-plain of Squares made by lines drawn from the Viſual point *a*, and the point of Diſtance *b* to the Baſe, as by Operat. XV. This Ground-plain contains ſeven Squares in length, and ſeven in bredth, whereof

the thickness of the wall on either side takes up one quarter of a Square, as is seen at **a b**. In the Wall is made a Door, containing in bredth three Squares on the Ground-plain, as *s x t v*; and if you draw two lines from the opposite angles of the Door, where they intersect each other shall be the middle of the Door; as you may try on the other side of the Wall, where lines drawn from *f h* and *g i* intersect each other at *k*, which by the Perpendicular *k l* you may find falls in the middle between six Scenographick Squares: that is, three is contained between *l* and *i*, and three between *l* and *f*.

In the furthermost side of the Wall is a Thorow-fare made of the same height the Door is, by drawing the Diametral *t v* from the Visual point *a* and continuing it to *e* at the angle of the two Walls, and from thence by drawing the line *e d y* parallel to the Horizon, which Thorow-fare (being of the width of three Squares, as between *e* and *z*) is described by erecting Perpendiculars from the points *e z* to cut the Parallel *d y* in the points *d y*, as you may see in the Figure: And so the Thorow-fare *d y e z* Orthographically becomes equal to the Scenographical Door *t v s x*.

To bear up the Roof of the Chamber, here is described five Joysts laid upon the side of the Wall, *q h* the depth of which Joysts are described by the Perpendiculars *q r* and *p o*, and the bredth by *m q* and *o h*; each Joyst is of equal bredth, and lies of equal distance one from another, so that by laying a Ruler to the Visual point and the points *m q r*, you may draw the lines f *m*, g *q*, h *r*, to represent the three corners of the first Joyst, The fourth corner lies out of sight. Do the like for the rest of the Joysts, all but the middlemost, which because the Ey lies just under it shews but two of its corners; as you may see in the Figure at *n*. Then if you will cover these Joysts with Boards, or Plancks athwart, you may for your better guidance divide the Ceeling into four Scenographick parts by drawing lines from the Angles **h i** to the the Angles *r p*; for where they intersect one another as in the point **k**, draw a line Parallel to *r p*, and that line divides the Ceeling into two Scenographick halfs: And other lines drawn from the points **h i** *r p* to the two ends of this Parallel l m do by their intersections give points on the middle Joysts through which two lines drawn Parallel to the line *r p* divide the whole Ceeling into four Scenographick parts as you may see in the Figure.

I have been the more Copious upon this *Operation*, because it is the first in this Book that shews the drawing of inward Edifices: And I would have you well understand it; because I intend instead of Repetition to refer you to this *Operation* when I shall have occasion to speak of things of the like nature.

*OPERA.*

## OPERATION. XXI.

### *To describe the inside of a Chamber with three Doors; one on either side, and one right before.*

THis is performed upon a Ground-plain of nine Squares in length and nine in bredth, (drawn as by Operat. XV.) I shall not need say any thing of the sides of the Wall, it having been taught in the last Operation: But the Doors standing partly open and partly shut require a little instruction to shew the designing of them in Perspective.

You must understand that a Door being hung upon hinges describes in its opening and shutting a Semi-circle. As for Example, If it stand wide open with the back side of it against the Wall, it fetches the sweep of a Semi-circle before it can shut upon the Door-frame that runs range with the Wall. Therefore having the width you intend your Door shall be of, and pitcht upon what place in the side of a Wall it shall move, (as on its Axis,) you need but describe on a loose paper a Geometrick Semi-circle in the same number of Squares that you intend your Door shall describe its Semi-circle in, and observe the points of the Parallels and Perpendiculars that this Semi-circle cuts, for the Scenographick Semi-circle must pass through the same points of the Diametral and Diagonal lines described on the Scenographick Ground-plain: As you may see the Door *a a d d*, containing six Squares (as from the center *a* to *e* three, and from *a* to *f* three) describes on the Ground-plain the Semi-circle *e l h i d g f*, which if you draw a Geometrick Semi-circle in six Squares you will find that this Scenographick Semi-circle passes through the same points of Diametrals and Diagonals as your Geometrick Semi-circle does through Parallels and Perpendiculars. Then consider how neer open or shut the Door is you intend to describe; that is, what angle it makes with the Wall; for the same quantity you must set off on your Scenographick Semi-circle; as here it stands open by the distance *f d g*: Therefore draw a straight line between *a* the center the Door moves on and *d* the edge of the Door, and prolong it into the Horizon, and that line *d a* shall be the under side of the Door: Then describe the same Semi-circle over the Door that there is on the Ground-plain, by erecting Perpendiculars from as many points as you please of the Semi-circle on the Ground-plain, and by drawing straight lines from each of those points into the center *a* and prolonging them into the Horizon; for where the Perpendiculars cut straight lines drawn from those several points in the Horizon through the upper center *a* of the Door and so prolonged shall be the points that the upper Scenographick Semi-circle e l i h d g f must run through.

If you would have the Door stand wider open that you may see more of the entrance as at *i i*, Draw (as before) a straight line from *i* to the center *a* and prolong it into the Horizon, as *i a k*, so shall *i* be

the under edge of the Door; and if from the point *i* you erect the Perpendicular *i i* for the edge of the Door, a straight line drawn from the point *k* in the Horizon to the point *a* in the upper center of the Door and prolonged shall give the line *i a* for the upper edge of the Door.

Thus may you describe a Door standing open to what width you please, as at *a a c c* the Door stands wide open with its back side against the Wall; at *a a l l* it shews less open; at *b b* it shews a Door whose edge lies almost in the same line its Axis does, and so the Door shuts nearer and nearer, as at *g g a a* the Door appears quite shut: the Door on the other side is made just after the same manner, and therefore needs no more Descriptions.

The Door in the middle stands also on three Squares, and also opens through six, and if you describe the Scenographick Semi-circle *m p q* as you were taught just now, you may set this Door also open to what width you please. Thus, Erect a Perpendicular on the point of the Semi-circle you intend to open the Door to, and prolong it quite through the Door as *r s*, and with your Compasses measure on the Perpendicular, the distance between that point in the Semi-circle and the Diameter of the Semi-circle, which is the line *m n*, where the Squares end; for that distance set off on the same Perpendicular from the Base as from *r*, shall give a point through which a straight line drawn from the Center of the Door *a* to the Horizon shall be the point in the Horizon from whence a straight line drawn to the upper end of the Doors Axis shall give the shortning of the upper edge of the Door, and the points where the two straight lines cut the Perpendicular shall be the points that shall shew the shortning of the fore edge of the Door.

Above this Door is made a round Hole of the same width the Door is, and of the thickness of the wall; which because the lines by which it is made, are so plain and the manner of working so easie I shall forbear farther Instructions on it.

Under this Arched Roof are drawn Parallel prickt lines to shew the devisions of the Roof: and by these devisions either with Compasses, or else a steddy hand, you may describe the Arches as you may see them in the Figure.

By the making the foresaid Doors may be understood how to make Casements standing open at any width, and several other *Operations* pleasant and necessary for all that Study Perspective.

## *OPERATION XXII.*

### *To Describe in* Perspective *the inside of two Chambers one above the other.*

THis is also performed by help of a Ground-plain, as in the former Figure: but the difference between this and the former is. 1. This hath another Chamber over it. 2. A Portal

Portal and Hole on one ſide of the Wall, and another right before you on the middle of the Ground-plain. 3. Steps placed juſt within this Portal. 4. A ſquare Hole in the middle of the Ground-plain. 5. Shelves on the other ſide of the Chamber.

1. For what concerns barely the Chamber over the lowermoſt Room you may ſee by the Figure that its Operation is the ſame with the former; where you ſee all the three ſides of the Chamber wholely, but becauſe the Ceeling *a b c d* of the lower Room lies ſo much above the Ey, you only ſee ſo much of the upper Chamber as is unobſcured by the Ceeling. That is, all above the Cauzes *a d* reſting on the two Cauzes *e f*: the reſt are only noted with prickt lines, as they would appear if the Ceeling were not interpoſed between the Ey and them: and the Joyſts over head are wrought as in the laſt *Operat.*

2. For the Portal on the ſide of the Wall you may ſee that it ſtands on three Squares on the Ground-plain, as doth the Portal right before you. Now to make the Arch over this Portal correſpond with the Arch of the Portal right before you, viz. of the ſame height as that Portal is, do thus. Draw a line juſt where the Arching begins parallel to the Horizon as *g h*, and prolong it to the corner of the fore-right Wall as at *g*: Then laying a Ruler to the Viſual point and the point *g* deſcribe the line *m g*, then draw another Parallel line on the top of the Arch of the Portal and prolong it alſo to the corner of the fore-right Wall as to *i*, and laying a Ruler to that point *i* and the Viſual point draw the Diametral line *n o i*, then erect two Perpendiculars *n l* and *o m* from the ſides of the Portal to interſect the ſe Diametrals, ſo ſhall you by croſſing the Angles of interſection have the Center *p*, and upper and lower bounds of the Arch; which a ſteddy hand may eaſily reduce into form.

This way of working is exact enough for Painters or other Artificers. But if you will be yet more preciſe, See *Oper.* XXV. XXVI.

The Hole in the ſide of the Wall in the upper Chamber is made after the ſame way, viz. by erecting Perpendiculars to the deſigned width, as here it is three Squares on the Ground-plain, (the ſame with the Portal) and by drawing Diametrals from the Viſual point for the depth of the Hole; for where the Perpendiculars and Diametrals interſect each other ſhall be the Angles of the Square that includes the Hole, and ſtraight lines drawn from Angle to Angle ſhall interſect each other in the Center of the Hole.

By the ſame way of working you have the back ſide of this round Hole deſcribed to the thickneſs of the Wall, and alſo the back ſide of the Portal (as you may ſee in the Figure.

In the other ſide of the Wall on the Ground-plain is made another half-round Hole; which being performed after the ſame manner needs no further Explanation.

3. Juſt within the Portal are placed four Steps going ſtraight upwards; which are thus made. Draw the two ſlope lines *q q* and *r r* (to what ſlope you pleaſe) parallel to each other for the width of the Steps; then aſſigne a depth for the firſt Step, as to *s*, and Parallel to

the Base draw a line for the bredth of the Step, as *t s*, then draw Diametrals from the points *s* and *t* to the slope line *q q*, so shall the first Step be made. The rest of the Steps are made after the same manner; observing that all the several Steps on their several Perpendiculars are equal in depth to the first.

4. In the middle of the Ground-plain is made a square Hole as *v x z*, which may serve for an Entrance down a pair of Stairs leading to some Vault or Cellar. These Stairs are in length three Squares, and in depth the transferred distance of one Square, as you may see the depth of the first Step downwards is *v x*, which is the transferred distance of *v y*, the bredth of the Step is *x a*, so that a Diametral drawn from the Visual point to *x* and so prolonged directs you to the second Step at b, and by placing one foot of your Compasses at the point c, which is in the same Diametral the point *v* is, and extending the other to the point d (which also is in the same Diametral the point *y* is) you transfer the distance of d c to c b which is the distance *y v* transferred to *v x*; and another Perpendicular erected from the point b to c shews the depth of the second Step. The rest of the Steps are made after the same manner.

5. On the other side of the Chamber against the Wall is set three Shelves, two above the Horizontal line, and one below, as e f g. The further ends of them rests in the Wall right before you, and the hither end is fastned to a Post erected Perpendicularly on the Ground-plain; the bredth of these Shelves are one Square on the Ground-plain, as you may see by the line h i, from which Diametrals prolonged to the Post the several Shelves are described.

Here you may note that by the several places of these three Shelves you have several appearances of them; for the Shelf g lying under the Horizon shews its upper Plain. The Shelf f lying a little above the Horizon shews its under Plain, though much fore-shortned. The Shelf e lying pretty high above the Horizon discovers the under Plain more intirely. But on the other side the Wall you have the Shelf k, which because it stands just in the Horizontal line discovers neither the upper or under Plain, but only the very edge of the Shelf.

## OPERATION XXIII.

### *The manner of placing Columns behind one another in* Perspective.

THough this may be performed by a Ground-plain of Scenographick Squares, (as before,) yet because in this Operation no work comes between the two rows of Collumns we shall need describe no more of the Ground-plain than will serve our turn.

Therefore having drawn your Horizontal line to your designed Height

Height above the Base, and set off your points of Distance at equal distance on either side the Visual point, Draw the Diametrals *a a*, *b b*, *c c*, *d d*, Then from the points of Distance draw the Diagonals *e d*, and *f a*, and at the points of intersection of these Diagonals with the Diametrals draw straight lines parallel to the Base, and these straight lines continued to the outmost Diametrals shall make four Scenographick Squares, whereon four Columns must be placed; as here the Squares *a b* and *c d* and *g* and *h* &c.

If you would have more Columns stand behind these four, Draw Diagonal lines from the innermost Angle of the hindmost Squares already made, as from *g* and *h*, and those Diagonals shall intersect the Diametrals in c d and b a, from which angles of intersection straight lines drawn parallel to the Base and Horizon shall make the Scenographick Squares whereon two other Columns shall stand.

By this manner of working you may set more Columns behind these, till you almost fill the whole Ground-plain.

Having thus projected these Scenographick Squares whereon the Columns must stand, you must erect Perpendiculars from every angle of these Squares through the Horizontal line and so upwards to the height your outmost Column ought to be, as here to the line *i k* parallel to the Horizon; for the points where Diametrals intersect this line and the Perpendiculars *a i* and *d k* shall be angles impending perpendicularly over the respective angles of each respective Square in the Ground-plain: As here the angle *i* hangs directly over the angle *a*, and the angle *k* hangs directly over the angle *d*: Then from the points of Distance draw Diagonal lines to the points *i k*, and where those Diagonals intersect the Perpendiculars erected on the Diagonal angles of the Square in the Ground-plain must another line be drawn parallel to the Horizon, and also other Diagonal lines which shall include the Squares that hang over the two first Squares in the Ground-plain.

The other Squares are found after the same way, viz. by the mutual intersections of the Diagonals with the Perpendiculars. As may be seen in the Figure.

The Arches over these Columns are very easily made: for by drawing the Perpendicular through the Visual point in the Horizon into *l* you have all the lines drawn parallel to the Horizon devided into two equal parts, And by placing one foot of your Compasses in the middle of the respective Parallel lines and opening the other to the angles of the Square that lies in the same Parallel line you may describe those respective Arches. As for example. If you place one foot of your Compasses in the middle point on the line *i k* and extend the other to the point *i* or *k* you may describe the outmost Semi-circle, and by closing the Compasses to the other angle of the Square which lies in the same line, you describe the second Semi-circle; for the third Semi-circle you may place one foot of your Compasses in the middle of the next parallel line and extend the other to the point *o* in the same line, and describe the Semi-circle *o p*. This work

is so plain and easie to be understood by the Figure, that I need discourse no further upon it.

In this Figure you may note, what correspondence the Squares above the Horizon have with those below the Horizon. Yet as the Squares above the Horizon have a greater distance from the Horizon than those below the Horizon have, it falls out that the upper Squares are larger than the under Squares. The reason whereof you may easily see by consulting the Figure.

And as the Squares have a correspondence, so also have the Diagonals; for the crossings of the Diagonals above the Horizon respond with the crossings of the Diagonals below the Horizon.

## OPERATION XXIIII.

### *To describe in* Perspective *the appearance of four* Pilasters, *with four* Beams *upon them; And to make an* Arch *over them.*

THis is also performed by a Ground-plain of Squares, which consists of seven in bredth and seven in depth: Described as by Operat. XV. The Pilasters *a b* and *c d* standing each on one Square erected perpendicularly on the angles of the Ground-plain, and divided upwards into three equal parts, as 1 2 3 with straight lines parallel to the Horizon drawn through the fore side of them: But the lines that devide the inside the Pilasters are Diametrals drawn from the Visual point to the inmost corner of the foreside of the Pilaster. As you may see by the Figure.

Upon these Pilasters is laid a Frame of four Beams, serving for bond to the Pilasters, as *e f g h*, two of which viz. *f h* are drawn from the Visual point. And over these four Pilasters is erected the Arches *i k l* and *m n o* to be seen quite through; which Arches being to be made as those in Operat. XXI. XXIII. need here no further discourse on them. Only you must note, that what lines of devisions you make on the Orthographick or fore-side of the Arch you must draw from the center of each respective Arch, and the devisions on the under side of the Arch must be drawn by the side of a Ruler laid to the Visual point and to the devision on the corner of the fore side the Arch, as the devisions of the Pilasters are.

## OPERATION XXV.

### *The manner of making Side Arches in* Perspective.

HAving drawn an Horizontal line, describe a Ground-plain of Squares, (as by *Operat.* XV.) and thereon draw a Scenographick Circle (as you were taught by *Operat.* IX. X.) and mark it from the middle line with 1 2 3 4 5 on the Base; and on the

the side with *a b c d e f g h*: Then erect a Perpendicular on the corner of the Ground-plain of the height you intend your side Wall shall be as *h i*, and erect another Perpendicular on the corner of the Ground-plain as 5 5, and by drawing two Diametrals through the Visual point the point 1 and the point 5 on the top, and from the Visual point through *b* to 5 on the Base, you shall have the Scenographick appearance of the side of the Wall wherein the Arch shall be made. Then from the point h (which you may see by the Orthographick or fore-right Arch is the point where the Arching begins,) draw another Diametral into the Perpendicular line 5 5 as h 1, and you will find the same distance between 1 5 on the Perpendicular as there is between 1 5 on the Base: But the rest of the distances you must transfer, as the Distance between 1 2 on the Base you must transfer from 1 to 2 on the Perpedicular, and the distance 1 3 on the Base you must transfer from 1 to 3 on the Perpenicular: And so for the rest.

Then from the points *a b c d e f g* on the Ground-plain erect Perpendiculars into the Ceeling and where Diametrals drawn from the points 1 2 3 4 5 intersect these several Perpendiculars shall be the points through which the Arch must pass. For Example. Where the Diametral drawn from the point 2 on the Perpendicular, intersects the Perpendicular erected on the point *a* on the Base, as here it doth in a, shall be one point through which the arching must pass, and where the Diametrals drawn from the point 3 intersects the Perpendicular erected on the point *b* on the Base, as here at b shall be another point through which the Arch must pass: And so also the intersections from 4 and 5 with the Perperdiculars *c d* in the points c d, are points through which the Arch must pass.

For finding the other points through which the Arch must pass, you must go back again to 4 and see where that Diametral intersects the Perpendicular *e* for there shall be another point, and where the Diametrals from 3 2 1 intersects the Perpendiculars *f g h* shall be the other points through which the Arch is carried.

Having finisht this Arch the other Arch is easily made, for by drawing Parallels through the points 1 2 3 4 5 in the top to the points *k l m n o*, and also Parallels from the points a b c d e f g h, Diametrals drawn to the points *k l m n o* will intersect the Parallels drawn from a b c d e f g h in the points through which that Arch must also pass.

On the Ceiling is made a Circle as it lies below on the Ground-plain of the Floor, as it appears in Perspective at that Height.

On the right hand of the Ground-plain is erected the same two Arches that are on the left hand, whose Operation is in all respects the same: Only on the right hand is drawn straight lines from point to point, and on the left arching lines which makes this on the right hand represent it self (not as an Arch, but) as part of a Figure made up of eight Squares.

# OPERATION XXVI.

## The making of Croſs Arches in Perſpective.

IN this Figure is deſcribed four Arches, viz. one Orthographick Arch, which is the great Semi-circle marked 1 2 3 4 5 6 7 8 9, an Arch behind it Perſpectively deminiſhed, marked 9 *a b*, and the two ſide Arches, whoſe Diametrals are 1 9 and *b* 9. Theſe four Arches are required to be made before you can make Croſs-arching, As in the Operation you will find. Therefore having deſcribed the two ſide Arches (as by the laſt Operation) you muſt devide the Orthographick Arch or Semi-circle into eight equal parts, and from the Viſual point draw Diametrals to every one of them, as 1 2 3 4 5 6 7 8 9; Then from the points where the Perpendiculars cut the Diametrals of the ſide Arch, as in 1 2 3 4 5 6 7 8 9, Draw lines parallel to the Horizon to interſect the reſpective Diametrals of the Semi-circle; for thoſe reſpective interſections ſhall be the points through which the Croſs-arching muſt be drawn. As for Example. Draw a line parallel to the Horizon from the point 2 in the ſide Arch to the Diametral 2 in the Orthographick Arch, and that ſhall be one point through which the line of Croſs-arching muſt run. Then draw another parallel line from the point 3 in the ſide Arch to the Diametral 3 of the Orthographick Arch, and there ſhall be another point through which the Croſs arch muſt run. Then draw another Parallel line from the point 4 in the ſide Arch to the Diametral 4 of the Orthographick Arch, and there ſhall be another point through which the Croſs-arch muſt run. Do the like from the points 6 7 8 9, ſo ſhall you have all the points through which one of the lines of the Croſs-arch muſt run.

The other Croſs-arching viz. the Arch *b* 8 9 on the other ſide, is drawn by continuing the Parallels which you drew from the points 2 3 4 5 6 7 8 9 of the ſide Arch into the Diametrals 9 8 7 6 5 4 3 2 1, for at the interſections of the Parallels with theſe Diametrals ſhall be the points through which the line of Croſs-arching muſt paſs; which is indeed nothing but the Arch on the other ſide reverſed.

This way of working is very eaſie, and the truth of it very perſpicuous. For as this line of Croſs-Arching impends the Diagonals *k l m n* on the Ground-plain, ſo would you find that if Perpendiculars were erected from the points *o p* &c. on the Ground-plain, they would run into the points where the Parallels and Diametrals cut each other above in the Croſſing of the Ceeling, which is a proof ſufficient to verifie the truth of this Operation.

OPERAT.

## OPERATION XXVII.

### *To erect a Structure on an* Octagonal Ichnographie.

THe Height is *a b*, the distance *b c*. Having described your Ground-plain Scenographically, as by *Operat.* VIII. Erect on the two Orthographick Angles thereof d *d* e *e* Perpendiculars to include the side, and through these two Perpendiculars draw a line parallel to the Base and Horizon, at the height you intend your upright work shall break off, as d e: And at the intersection of this line with the Perpendiculars d *d* e *e*, draw lines from the points of Distance *b* on your left hand to d, and from *b* on your right hand to e, and from the points where those lines of Distance or Diagonals cut the Perpendiculars l *l* and f *f*, draw Visual lines to the Perpendiculars k *k* and g *g*; then from the point of Distance *b* on your left hand draw a Diagonal from g to the Perpendicular h *h*: And from the point of Distance *b* on your right hand draw another Diagonal from k to the Perpendicular i *i*. And lastly from i to h draw a line Parallel to the Base and Horizon, so shall the Scenographick Ichnographie of this Building be transferred to the top and all the sides of your Perpendicular Building shall have their Scenographick Heights. You must note that those sides of the Ichnographies that ly behind the Orthographie are to be drawn with obscure lines only, to direct you in the more true placing the Moldings, &c. in the rest of the work.

The hollow of the Ichnographie is found in the Roof, by erecting Perpendiculars from every point of the Geometrick Circle, and every point of transferred distance to the line of the Roof d e, for then by drawing Diagonals through every point of transferred distance aforesaid, those Diagonals shall cut the Perpendiculars in the several points through which the Circle in the Roof must pass.

The Frame-work of the Spire (as you see) is raised on the upright Angles of the Figure in the Roof, and meets at the Perpendicular erected on the Center of the Scenographick Ichnogtophie, which you may find as by *Operat.* XX. &c.

## OPERATION XXVIII.

### *To describe a Fabrick supported with Columns.*

DRaw a Ground-plain of Squares, as by Operat. XV. and on the Squares at the four corners of the Ground-plain, and also on your middle Square erect your Pedestals and Columns, of the true height the Order of the Column you pitch up-

on ought to be: That is, that the Column Pedeſtal and Capital contain ſo many Models in length as a Column Pedeſtal and Capital of the *Tuſcan, Dorick, Ionick, Corinthian,* or the *Compoſite* Order ought to do. Allow alſo all the Members on the Orthographie or Front their Architect Demenſions: and all lines that are parallel to the Baſe in the Fabrick make parallel in the Figure; and all lines that are perpendicular in the Fabrick make perpendicular in the Figure.

By lines Parallel to the Baſe I mean Lines on the Front, or Directly oppoſite to the Front behind, which muſt be drawn Parallel to the Baſe, and not the lines on either ſide the Front, although indeed they are in the Fabrick as well Parallel to the Baſe as thoſe in the Front. But thoſe lines in Scenographie are all drawn from the Viſual point, and (as you may ſee in the Figure) fore-ſhorten thoſe ſides they repreſent.

If you liſt to erect more Columns behind theſe, you may draw the Ground-plain of Squares neerer to the Viſual point, and by the Rules you have already placed theſe, ſet as many as you think good.

## OPERATION XXIX.

### *To Deſcribe in* Perſpective *the Appearance of ſeveral* Columns *placed behind one another.*

ALthough you have hitherto been directed to draw a Ground-plain of Squares, yet may it more readily be performed (as you may ſee in this Figure) by Diametrals and Diagonals without drawing the whole Ground-plain: For by Diametrals drawn from the Viſual point *c*, you have the range of the whole row of Columns, and alſo the range of every member on the Column, and by the Diagonals drawn from *b b* you have the fore-ſhortning bounded.

As for Example. Having on the Baſe ſet off the bredth of the Pedeſtal as *a d* from the Viſual point *c*, draw a Diametral, and that Diametral ſhall be the range of the whole row of Columns: And by drawing a Diagonal from the point of Diſtance to the point *a* you have at the interſection of the Diametral with the Diagonal in the point *e* the fore-ſhortning of the inſide of the Pedeſtal *d, e*, then by erecting the two Perpendiculars *d f* and *a g* for the height of the Pedeſtal, and by erecting the Perpendicular *e h* at the point of interſection with the Diametral *c e d* and the Diagonal *b e a*, and by drawing the lines *f g* and *h i* Parallel to the Baſe, and the Diametrals *h f* and *i g* you have the Pedeſtal included in all its viſible ſides, and the Square *h i f g* ſhall be the Scenographick Plain of the top of the Pedeſtal, and the interſection of the Diagonals *h g* and *i f* ſhall be the Center of the Plain as at *k*.

By this way of working all the other Pedeſtals are erected, and all their viſible and inviſible Sides and Angles found. For Example. The black lines are the bounds of the viſible Sides and Angles, and the prickt lines the inviſible, viz. of thoſe Sides and Angles that ly behind the Orthographie or foreſide of the Pedeſtal. Having

Having thus placed the Pedestals you must erect your Columns thereon, and over them the Capitals by erecting Perpediculars from the Center of every Square plain on the upper side of each Pedestal, and as the several Bases are bounded by Diametrals, Diagonals, and Parallels: so are the several Capitals, and the Centers of their several Plains found by Diametrals, Diagonals, and Parallels; as in the Figure you see the Capitals *l m n op:* which being so very plain needs no further description, especially considering that on the left hand you have the work finisht up according to its true Perspective appearance.

## OPERATION XXX.

### *To Describe in* Perspective *the Appearance of a Stately* Structure.

HEre you have on a Ground-plain of Squares described, first, an Ascent of two steps, and on them a Porch with four Columns, as *a b c d*, and arched over with cross-arches. The placing and ordering the Columns has already been taught in *Operat.* XIX. XXIII. XXIIII. The chief thing remaining to be treated of is the Cross-arches, which that you may the better understand how to describe in Perspective, You may consider that all Cross-arches are made upon four Columns which stand upon the four Angles of a Geometrick Square, (though here we set them on a Scenographick Square) and that the two Arches that cross each other proceed from the two Columns that stand corner-wise against each other: so that each Semi-circle is cut by the other into two Quadrants. The Orthographick appearance of these Semi-circles viz. the Semi-circle *e f* and *g h*, are described as hath been taught in *Operat.* XVII. XIX. XX. XXII. XXIIII. where you may see they are only Arches of Circles, and therefore need no more comment on them, and the other Arches are thus found. Draw a Diametral from the middle of the Semi-circle *e f* as at *i*, and in that Diametral shall be all the intersections of the several Arches that intersect each other, (which as was said before are only those Arches that are made over the Columns that stand corner-wise from one another) Then draw another Diametral from the Center of the same Orthographick Arch *e f* as at *k*, and prolong it towards the Visual point as through *l* and *m* to *n*, for in this Diametral shall be the Center of the Arch *o p*, as here in *l*, the Center of the Arch *q r*, here in *m*, the Center of the Arch *q h*, here in *n*. For the Arches *o s* and *g s* you must cross the corner Columns *a d* and *b c* in the Floor with two straight lines, and they will intersect each other in *c*, from which point erect a Perpendicular; then from the point *i* in the Orthographick Semi-circle draw a Diametral, and where that Diametral intersects,

the Perpendicular as here in *s*, shall be the point where the Arches shall cross each other; and for describing the arch which is alwaies a Quadrant of a Circle, measure with your Compasses the distance between *o* and *s*, and on a loose paper (or other thing) make a Geometrick Square whose Sides shall be equal to that measure, and with a straight Ruler cross that Geometrick Square in its Diagonal Angles; and the distance between the intersection of these two straight lines, and one of the Angles of the Square shall be the Radius to a Circle of the same sweep the Arch *o s* shall be of, and the Center of that Arch is found by placing one foot of your Compasses first in the point *o*, and with the other describe an occult Arch, as at *v*, afterwards remove one foot of your Compasses to the other end of the Quadrant and with the other foot describe another occult Arch to cut the former, and in that point of intersection shall be the Center of the Arch *o s*. Use the same way to describe the Arch *g s*.

The Columns **x a b y** are all set Perpendicularly over the Columns *x a b y* and the two Pinacles over the Columns *c d*, as you may see by the prickt Perpendicular lines: so that what remains to be said of this Figure may be understood by the Figure it self, as well as by many words upon it.

## OPERATION XXXI.

### *To describe a* Square *with* Ascents *of* Steps *about it.*

A Square that hath Steps to ascend on all four sides hath all the sides of those Steps parallel to the undermost Step: Therefore in making the Ichnographie of this Figure you must include so many Squares as you think good within your outmost Square, all equidistant from and parallel to the outmost Square: And from one half of the Ichnographie produce the Scenographick Ground-plain for what Height and Distance you please.

Having therefore designed the Height *a b* of the first Step *b c*, Describe a parallel Scale, Thus, Draw a straight line from the Base to any convenient part of the Horizon, as here to *d e*, then prolong the line *b c* into this line, as into *f*, then from the Visual point draw a line through *f* into the Base, as at *g*, and from the point *g* draw a line to the point *e* in the Horizon, Then transfer the distances **a h**, **a i**, and **a k** on the Diagonal line in the Scenographick Ichnographie to the Diagonal line *a l* in the Structure, as to *a h*, *a i*, *a k*, and from those points on that Diagonal line raise the Perpendiculars *h m n*, *i o p*, *k q r*, Then from the point *b* draw the Diagonal *b m*, and where that Diagonal *b m* cuts the Perpendicular *h m* shall be the bottom of the under Step *m s*, which Parallel line must be continued into *t*, for by drawing the Visual ray from *t* to the Visual point you will cut the line *d e* in *v*, from whence

whence the line *vw* drawn parallel to the Horizon gives the top of the ſecond Step: Then by drawing the Diagonal *no* you have the bottom of the third Step at *e*, from which point a Parallel drawn into *gr* and a Viſual ray drawn from that point in *ge* ſhall cut *de*, from which interſection in *de* a Parallel drawn into *p* ſhall give the top of the third Step. The like you muſt do for the fourth Step. Then laſtly, draw a Viſual ray from the point *a* and a Diagonal from the point *x* to *y*, and where the foreſaid Viſual ray cuts this Diagonal erect a Perpendicular into the Viſual ray *bz*, and from the point *z* draw a line parallel to the Horizon as far as the ſecond Step, which ſhall ſhew how much of the hind part of the firſt Step will be ſeen. The ſame way you may find how much of the other Steps appear, as you may ſee in the Figure: for where the Diagonal *xy* cuts the ſeveral Viſual raies, in thoſe points the Perpendiculars erected into the Viſual raies before, it ſhews how much of the hind part of each reſpective Step appears.

On theſe Steps you may place a Fountain; a Pyramid, or a Column, as is lately erected in *Covent Garden* in the middle of the *Piatzo*.

This Parallel Scale is of great uſe, for by help of it you may ſet any Object in its true place, as well as with a Ground-plain of Squares: But you muſt remember to place your Perpendicular at the point of Diſtance, and ſo let it fall into the Baſe, for then by drawing a ſlope line from the point of Diſtance to any deviſion of the Baſe, and by drawing a Diametral to the Prependicular in the Baſe, where the Diametral cuts the ſlope line ſhall be the Height of the firſt parallel line of the Scale: and by drawing another Diametral to the point where the firſt Parallel cuts the Perpendicular the Diametral ſhall cut the ſlope line in a point through which a Parallel drawn ſhall be the ſecond Parallel line, &c.

## OPERATION XXXII.

### *How an Object that is to be placed high above the Horizontal line, ſhall be made that it appear equal to an Object placed but a little above the Horizontal line.*

BEcauſe thoſe Viſual Raies that proceed from the Center of the Ey ſtraight and directly forwards are more ſtrong than thoſe that decline towards the right or left hand, or are either elevated or depreſſed above or below the Horizontal line. Therefore any Object that ſtands at a convenient diſtance in the Horizontal line directly before the middle of the Ball of the Ey appears more perfect and true in ſhape and demenſion than if it were placed any where elſe, as may be proved by placing two Objects of the ſame ſhape and demenſion one in the Horizontal line juſt before you on a

Wall, and the other right above it at some considerable height on the same Wall; for you will find that the Object thus elevated will appear less than that which is placed on the Horizontal line: and that if the same Object be placed yet higher it will appear yet less and less. Therefore to know how big you shall make an Object for any given Height and Distance above the Horizontal line that it appear equal to an Object placed right before you in the Horizontal line, You must first consider, That as the Object that lies right before the middle of the Ball of the Ey in the Horizontal line appears most perfect, and by consequence shews its truest demension; So the Object that is placed higher or lower, or on the right or left hand appears less perfect, and by consequence requires a greater demension to make it appear perfect; for the Sight moving circularly in the Ey makes on a Wall the devisions of a Tangent line; and by so much as a Tangent increases upwards, in such proportion does the strength of the Optick faculty of the Ey deminish upwards. Therefore the Object that shall be placed any considerable height above the Horizontal line, and to be seen from a designed Station must exceed the Object placed just above the Horizontal line in such proportion as the Tangent of that Arch does the Tangent of the Arch just above the Horizontal line.

This Rule is very brief, and perhaps may not be understood by all Speculators in Perspective; Therefore I shall a little inlarge hereon, Because it is of eminent concernment in the true Seeing, Judging and making of Figures.

Having designed your Distance from the Wall; Set it off from the point your Ey is placed in; then set one foot of your Compasses in that point, and with the other describe the arch of a Circle, and devide it into so many equal parts as you please. So shall the raies that proceed from your Ey continued to the Wall shew on the Wall in what proportion the Object ought to increase to appear so large as an Object that is to be placed just before you on the Horizontal line.

For Example. Your Distance from the Wall is *a b*, Therefore at the point *a* describe the arch 1 2 3 4 &c. which you may devide into so many equal parts as you please, and by laying a straight Ruler on the point *a* and on every one of those devisions, that straight Ruler will point out on the Wall or on the line *bc* which represents a Perpendicular line on the Wall the several sizes that an Object is to be of placed on those several Heights to make it appear equal to the Object placed just above the Horizontal line.

But that great Master *Albert Durer* hath very handsomly handled this Operation in an erected Pillar, wherein he hath made an Inscription in Letters, thereby demonstrating how much those Letters that stand high above the Ey must be made bigger than those that ly neer the Horizontal line: as you may see by this annexed Inscription.

Having thus performed the Operation, you will see how much bigger the Letters far above the Ey are than those that ly neerer to the Ey. And this Rule is to be observed not only in the magnifying of Letters thus placed one above another, but also in magnifying of Figures

gures to be placed one above another on a Wall, be they either Painted or Carved.

## OPERATION XXXIII.

### *To Describe in* Perspective *a pair of Winding Stairs.*

HItherto we have imagined the Glass to be placed Perpendicular to the Base, and therefore as hath been said in CHAP. III. Those lines of a Figure that in a Geometrick Figure are Perpendiculars, are in the Scenographie also Perpendiculars; as here is seen in these winding Stairs; where because these Stairs should diminish upwards, the Glass is placed Oblique to the Base. But to the matter.

This Geometrick Ichnographie is divided into sixteen equal parts, as 1 2 3 4 5, &c. which represents sixteen Steps that wind once about the Newel. Therefore reduce this Geometrick Ground-plain into Scenographie, as you were taught in *Operat.* X. by erecting Perpendiculars into the Base &c. and mark the Scenographick Ichnographie with the same Figures the Orthographick is; then on the middle of the Scenographick Ichnographie at the point 13 erect the Perpendicular 13 *a*, and divide it into so many equal parts as you please or intend to have Steps, and erect another line on the same point 13 into the point of deminution as 13 *b*. Then from every one of these devisions on the Perpendicular 13 *a* draw a Visual raie from the Visual point *e* to the line of deminution 13 *b*, and from the points where those Visual raies cut this line of deminution 13 *b*, draw Paralles to the Base into the middle of the Newel; and those Parallels shall shew the Distance or Height of every Step one above the other on the Newel. And for the Distance or Height of the further end of every Step you must erect a Perpendicular on the extream point of the Ichnographie as *de* of the same length your Newel is; and devide it into so many equal parts as you have Steps, or as your Newel is devided into unequal parts, as *f g h i k* &c. to *t*, and from the Visual point draw Visual raies through every one of them to intersect every respective line of deminution raised out of the Ichnographie so shall Parallels drawn from every intersection shew the height of the further end of every respective Step, as the first intersection is made on the first line of deminution *d* 17 at 1, therefore a Parallel drawn from the point 1 where the first Visual raie intersects the Parallel line 1, shall shew the height of the further end of the first Step. The second Visual raie is drawn into the second line of deminution to the line 2, therefore the Parallel drawn from that point shall shew the height of the further end of the second Step. The like is to be understood of all the other Steps.

Then for the length of every Step, instead of erecting a Perpendi-

cular on the ſeveral points of the Ichnographie to find them as you have been often taught before; Draw ſeveral lines from the point of deminution which is in the top of the Newel into every one of thoſe deviſions on the Ichnographie, and thoſe lines of deminution ſhall bound every reſpective Step: As that raiſed out of the point 1 of the Ichnographie ſhall ſhew the length of the firſt Step. That raiſed out of the point 2 of the Ichnographie ſhews the length of the ſecond Step: and ſo for all the reſt.

## OPERATION XXXIIII.

### *Shewing the further proceſs of the laſt Operation.*

BEcauſe the multiplicity of lines in the laſt Figure may ſomewhat confound a Practitioner, here is inſerted another Figure of a pair of winding Stairs, quite finiſht, made by the Precepts of the laſt Operation. So that the lines that were in the laſt Figure incumbred with other lines appear naked here: and the places of the Shadows which there are troubleſome to find out are here viſible to the Ey. Herein (as before) you have two turnings about the Newel, and the whole Deſigne projecting forwards.

If you would have more turnings about the Newel, you muſt devide the two lines of deminution on each ſide into ſo many the more parts: As you were taught in the laſt Operation.

## OPERATION. XXXV.

### *The Deſcription of a pair of Double Stairs, whereon two perſons the one aſcending the other deſcending ſhall not come at one another.*

THeſe double Stairs are inſerted as a peece of Rarity, and deſcribed only in Orthographie, and not by the ſtrickt Rules of Perſpective, leſt with many lines the work ſhould be obſcured. Yet ſuch as liſt to be curious therein may in the laſt (and ſeveral other) Operations find Rules whereby they may effect their purpoſe.

Deſcribe a Circle (or which is equivalent a Semi-circle) for the Ichnographie, as 1 2 3 &c. to 13, and in it deſcribe a ſmaller Circle, as *a b e* for the bigneſs of the Newel: Then devide the great Semi-circle into twelve equal parts, as 1 2 3 to 13, and draw lines from thoſe deviſions into the Semi-circle made for the bigneſs of the Newel, ſo will that Semi-circle alſo be devided into twelve equal parts: Then on every one of the points in the great Semi-circle erect Perpendiculars, and thoſe Perpendiculars ſhall ſhew the ends of each reſpective Step. As the Perpendicular at 1 1 bounds the outward end of the firſt

firſt Step: The Perpendicular at 2 2 bounds the ſecond Step, &c. to 24. which makes good a whole Circle in the Ichnographie; and Perpendiculars erected from the inner Semi-circle marks on the Newel the ends of the ſame Steps. Work the ſame way with the Steps on your right hand.

You may perceive that the winding of theſe Steps about the Newel may properly be compared to the winding of a thred about the Spindle of a Screw, And that as thoſe Spindles that have but one thred winde not ſo ſuddenly about the Spindle as thoſe that have two threds; So theſe Stairs having two Aſcents, each begun Diametrically oppoſite to the other winde more ſuddenly about than thoſe that have but one Aſcent: and therefore it is requiſite the whole Circle be devided into twenty four parts for theſe ſort of Stairs, when as other Stairs have the Ichnographie devided but into twelve or ſixteen equal parts.

The Newel is pierced through in ſeveral places only to let in Light.

Who was the firſt Inventer of theſe Stairs is not well known. But at *Sciamburg* in *France* in the Kings Pallace is a pair of them, made by *Piedro del Bergo*, and *Iehan Coſin*. They are alſo ſet forth by *Vignol.*, in his Book of Perſpective, from whence this is taken.

## *OPERATION XXXVI.*

### *To Delineate in* Perſpective *a* Platform *with* Columns, Pilaſters, Railes *and* Banneſters, *as it is ſeen from above, where the Ey is placed directly over it at ſome reaſonable height.*

YOu were ſhewn in *Operat.* XXVI. that an Object placed far above the Ey deminiſhes. It is the ſame thing with an Object placed far below the Ey. For as you were told in Chap. II. *Defin.* III. The Viſual raies do at laſt meet in a point: Therefore in this *Operat.* the Ey being placed above the Ediſice, the upper Railes ſeem larger and wider than the under Railes, and the Banneſters under the upper Railes in *a b c d* appear greater than the Banneſters in *e f g h*, becauſe the upper Rails and Banneſters ly neerer the Ey than the under, and ſo gradually the Object deminiſhes till you come to the Plat-form *i k l m*, on which Plat-form you may note that the Square deviſions being fifteen in length, and ten in breadth, are all equal among themſelves; becauſe the Glaſs is placed Parallel to the Horizon. And as you were told in Chap. II. *Defin.* VI. where the Glaſs is Parallel to the Horizon, all Objects on the Horizon have a true Orthographick appearance, but where the Glaſs is erected to cut the Horizon the Object ſeems a wry and ſhortens proportionable to the Angle the Glaſs makes with the Horizon, and ſo produces a Scenographick appearance. For, for this cauſe you have the Plat-form Or-

thographie, and the Structure thereon erected Scenographie; for as was said, the Plat-form lies parallel to the Glass, But the Structure is perpendicularly erected thereon.

This being rightly understood, you have already learnt the making this Edifice: For this Structure of Rails Bannesters Pilasters and Colnmns are erected on the four sides of the Base of the Plat-form by Visual raies drawn from the Visual point *n*.

Example of the whole. In the first place, That the upper Rail appears greater than the under, is (as was said) because it lies neerer the Ey: for if the Plat-form were elevated above the Pilasters the Squares thereon would appear as large as the Squares *o p q*: and if the Plat-form were elevated above the Columns, the Squares would appear yet greater by so much as the Diametrals are wider asunder: And by consequence, if the Plat-form were elevated to the upper Rail (which is neerest the Ey) the Squares would appear yet greater: But the Plat-form being so much farther off the Ey than the upper Rail, the Squares thereon draw neerer to the Visual point. Whence it also follows, that the Ranges of Bannesters in *e f g h* appear less than the Ranges of Bannesters in *a b c d*, But the Pilasters, Columns, Bannesters, &c. are all erected upon Visual raies, as you may see in the Figure.

## OPERATION XXXVII.

### *Of designing the Geometrick Ichnographie of a Garden-plot into a Scenographick Ichnographie, in order to erect thereon the appearence of Arbors, Trees, Hedges, Fountains, &c.*

THe Ichnographie here proposed is that of the Garden of the most Illustrious Prince of *Orange*, scituate in the *Hague*, it contains in length 172 Geometrick Feet, and in bredth 91 Feet, marked *a b c d*, having on the four angles four square Arbors marked *e f g h*. as also four round Arbors marked *i k l m*, with a Pavillion in the middle marked *n*, which Pavillion hath its entrance on four sides, viz. out of the two arched Galleries marked *o p*, and the two long Walks marked *q r*. Within this Ground-plot is contained two Garden plotts with four Walks in each Garden, which devides them into four equal parts apeece, leading to the middle thereof, where stands two Fountains, as at *s t*, encompassed with flower-pots, as also is the whole Garden between the outmost Walks and the Galleries: As you may see by the small round marks whereon they are to stand.

How to reduce this Geometrick Ichnographie into Scenographie you have often been taught in several fore going Operations.

OPERAT.

# OPERATION XXXVIII.

## *To erect on the Scenographick Ichnographie the Fences, Arbors, Quick-setts, Fountains, &c. of the aforesaid Garden.*

YOu have already the Scenographick Ichnographie laid down in the last *Operat.* To erect the foresaid appearances hereon you must raise Perpendiculars from the points whereon every particular thing is to stand, remembring as you were told in Chap. I. *Defin.* IX. that what ever lies right before the Ey is to be described Orthographically. viz. what ever is Parallel to the Horizon is to be drawn Parallel to the Horizontal line, what ever is Square is Square, or Round Round, as you may see in the fore Front of the Fabrick adjoyning to the Garden marked *a*, and the range of the fore and hind Wall. But if you behold any thing decline, from this Orthographick Front, though it be in the Fabrick a line Parallel to the Horizon, you are to draw it Scenographically, viz. from the Visual point, as you may see in the Walls that decline from the Front, making Angles therewith: and all the windows that you see in the foresaid Fabrick, how they do not ly Parallel to the Horizontal line, nor the side range of Columns on the one side, or Wall on the other: but all are drawn from the Visual point, as was said before.

This being considered the Operation proves easie, yet that this smal Figure and all the curiosities appertaining to it may be the better understood, I shall explain the whole designe, which briefly is this.

In this Figure is somewhat more than the Plat-form of the last Figure described, viz. the Banquetting House, and the long Gallery, and also the Wall of the Dwelling House of his Highness the Prince of *Orange* Fronting the Garden. This Wall is marked *a a*, on the right hand of which as at *b* you have the said Banquetting House, and close adjoyning to it the said long Gallery, with Columns after the *Dorick* Order, containing sixteen Arches, and Turrets, with several Lanthorns on the top of it. On the left hand as at *c* is placed a Bridge leading over a Mote which incompasses the whole Building into a curious fair Walk, which Bridge is inclosed on both sides, and covered over on the top: Beyond this Walk is an high Wall beginning at the hither side of the Banquetting House, and going round the Garden to the farther side of the Banquetting House, within this Wall is another Walk round the Garden, and at the four corners of this Walk four curious square Arbors: and at the middle of the Walk is placed a Portal for the entrance into a long Gallery, which goes quite cross the whole Garden which Gallery is all covered with green boughs, so close that the light of the Sun cannot pierce between them. On either side and at the ends of this long Gallery stands a round Arbor,

alſo cloſe covered with green boughs: within the Garden is erected on two Scenographick Circles two curious Fences of Quick-ſett, with four entrances into each at oppoſite points in the Garden, which having four paths a peece leads to a curious Fountain ſet round about with flower pots in the middle of the Garden.

Over three of the Arches of the long Gallery aforeſaid is erected part of the ſaid Banquetting Houſe: of four more of the ſaid Arches is made an Aviary well furniſhed with *Canary Birds*. And of the other nine Arches is made a Grott-work, with ſeveral curious delightfull Inventions of Water Works. The reſt of the curioſities of this Peece may as well be underſtood by the Figure it ſelf as by many words thereon.

## OPERATION XXXIX.

### *To Deſcribe in* Perſpective *a Folding-chair a Frame chair, and a Bedſted.*

HAving deſigned the ſpace in the Ground-plain that the Folding-chair ſhall ſtand upon, as here upon the Angles of four of the Squares, viz. *a b c d*. That is, The diſtance of each foot is two Squares from the next foot; ſet off ſuch an heigth from the Baſe as is proportionable to the length and bredth of the Chair: As here its heighth not being two Squares on the Baſe, viz. not ſo much as its length and bredth, the height wants ſomewhat of the Diagonal length of two Squares on the Baſe, which you muſt ſet off from the points *a* to *e*, *b* to *f*, *c* to *g*, and *d* to *h*, but you muſt note that for every foot you change your meaſure; for to the foot *a* that ſtands on the Baſe you take almoſt two of the Squares on the Baſe, to the feet *b d* that ſtands one Square above the Baſe, take almoſt two of thoſe Squares, and for the laſt foot that ſtands neereſt the Viſual point, take almoſt two of the Squares in that place, ſo that the meaſure of each foots height be taken from that Square in the Ground-plain that each foot ſtands on, as is taught in *Operat.* XVI.

And becauſe the Square of the ſeat of the Chair is broader than the Square ſpace that the feet ſtands upon in the Ground-plain the ſides of the Seat hangs over the ſides of that Square. Therefore in this caſe you may erect a Perpendicular from the points *a b c d* up to the Seat towards the point *e f g h*, but you muſt draw the Seat ſomewhat beyond it according as in your diſcretion you find the Seat of the Chair hangs over the ſaid Square, ſo have you the corners of the Seat *e f g h*: and by a Diagonal line the height of the Back *i k*. The Rails in the Back, and the Rails between the feet are all drawn by Diagonal lines, as you may ſee in the Figure.

If you would have the Corners of this Folding-chair turned more or leſs towards you, you muſt draw an Ichnographie of it, as you are taught in *Operat.* L. and then you may turn the Corners of that

that Ichnography into what poſition you will againſt the Baſe, and by perpendiculars erected on the Angles of the Ichnographic, as you were taught in the foreſaid *Operat.* the Corners of the Chair ſhall ſtand in their elected place.

The other Chair ſtands with its Foreſide directly before the Ey, and is between the two Forefeet, two and an half Diagonal Squares, and between the ſide feet two Diagonal Squares, ſo that from theſe points in the Ground-plain the feet or poſts of the Chair are made, by erecting Perpendiculars to your deſigned height, and then all the fore Rails of the Chair are Parallel to the Baſe and Horizon, and the Return or ſide Rails are Viſual lines, as you may ſee in the Figure.

The Bedſted ſtands with its feet *a b* ranging directly forward, and is in length ſix Squares, and in bredth five Squares; ſo that the Poſts are perpendicularly erected at this Diſtance to what Height you pleaſe: All the fore-Rails are parallels to the Baſe and Horizon, and the ſide-Rails are Viſual lines, as in the fore-right Chair. Therefore this Operation is very eaſie, unleſs it be the Teſter or Covering of the Bedſted, which becauſe it is ridged at the top, and the fore and hind ends incline towards each other, may ſeem ſomewhat difficult. For deſigning of which, Find the middle between the two Poſts *a b* in the Baſe, as at *c*, and draw the Viſual line *d c*, and therein deſigne how much the Teſter of the Bedſted ſhall fall away inwards from the upper Rail at the Feet, as from *c* to *e*; Therefore from the point *e* erect a Perpendicular to what convenient height you will above the upper Rail, as into the point *f*, and from the upper ends of the Poſt *a b* at the points *g h* draw ſtraight lines into the point *f* for that part of the Frame of the Teſter that belongs to the Foot end of the Bed-ſted. And to draw the hindmoſt ſlope of the Teſter you may do thus: Make a parallel Scale, (as you were taught in Operat. XXXI.) and on that Scale you may meaſure how much the angle *e* is erected above its Baſe, as here you will find a little more than one Square; therefore in the Ground-plain at the diſtance of a little more than one Square of that Parallel, under the line *i k* which is the bottom of the hind Feet, Draw an occult Parallel inwards within the Bedſted, becauſe the Teſter ſlopes inwards, as *m l*, and where that parallel cuts the Viſual line *d e c* ſhall be the angular point, as at *l*, and a Perpendicular erected on that point ſhall cut the Viſual line drawn to tho point *f* in the point *g*, which is the point that the hind part of the Frame of the Teſter muſt be drawn unto from the two hind Poſts. See the Figure.

Theſe Poſts are made ſquare becauſe the hind ſides and corners of them may be repreſented by prickt lines, For in Frame-work it requires that one half of the Rails &c. be drawn from the hind ſides and corners as well as from the fore ſides and corners, which by the help of theſe prickt lines you are directed to.

## OPERATION. XL.

### To describe two square Logg's unevenly laid one upon another.

THe nethermost angles of the under Log is imagined to ly towards the Base, and is marked with *a b c d*, from which angles if you erect Perpendiculars into your designed Height as to *e f g h*, and from these points and angles draw Parallels from *a* to *b*, from *c* to *d*, from *e* to *f*, and from *g* to *h*; and from the angles *a b e f* Visual lines, you have the under Log inclosed; and its hidden Sides and Angles markt out: as you may see by the prickt lines *g c* and *h d*, and the angle *c*.

The other Log whose bottom is markt with *i k l m* lies athwart the first Log, with one of its angles against the Base, viz. the angle *i*: Therefore to set this Log upon the first Log you must erect Perpendiculars from these four angles, viz. from *i* to *n o*, from *k* to *p q*, from *l* to *r s*, and from *m* to *t v*: Then draw Diagonals from the point *x* on the left hand to *p n*, *q o*, *r t*, and *s v*, and also Diagonals from the point *y* on the right hand to the points *q s*, *o v*, *p r*, and *n t*; and by erecting Perpendiculars from *p* to *q*, *n* to *o*, *r* to *s*, and *t* to *v*, the Log is inclosed.

## OPERATION XLI.

### To describe in Perspective a Form, a Table, and an Andiron &c.

THe Form stands with its ends before the Ey upon the width of two Diagonal Squares on the Ground-plain, as *a b*, and in length ten Diagonal Squares, as 1 2 3 4 5 6 7 8 9 10. You may make the Form of what height you please, as you may see by the Perpendiculars marked *a c*, *b d*, on the Seat of the Form. The Seat projects or hangs over the Form half a Diagonal Square on each side and end, therefore you must draw an occult Parallel at the distance of half a Diagonal Square within the Base on the Ground-plain as *e e* and *f f*, and two occult Diametrals at the distance of half a Diagonal Square on the Base from the Perpendiculars *a c* and *b d* inwards, as *g h*, which must be prolonged to the hind end of the Form; and where these Visual lines cut the Parallels shall be the outward bounds of the four Feet in the Ground-plain, which must be erected perpendicularly into the Seat. The fore and hind Rails of this Frame are Parallels, and the side Rails are Visual lines.

The Table on the left hand is placed with its corners against the Ey, and stands in length upon ten Diagonal Squares, and in bredth upon six; of which the Leaf of the Table projects over its Frame one Square on each

each ſide and end: The ſide lines for the Rails and the Leaf are drawn from the point of Diſtance *a* on the right hand, and the end lines for the Rails and Leaf from the point of Diſtance *a* on the left hand; and the Poſts of the Frame ſtand each upon one Square, and are all perpendiculars erected into the Leaf: So that here remains nothing of difficulty in this Figure, unleſs it be the projecting of the Leaf over the Frame, which though it be performed after the ſame manner of that on the Form, yet becauſe the Table ſtands not in the ſame Sight the Form does, I ſhall explain this alſo.

The Leaf of this Table hangs perpendicularly over ten Squares one way, and ſix another, in the Ground-plain; and this Square projects over the Frame one Square on each ſide, as hath been ſaid: Therefore find the lines in the Ground-plain that include the ten Squares, viz. *b* 6 and 10 *c*, and by taking away one row of Squares on every ſide the Ground-plain, you will have eight left one way and four another, which is the bounds and gives the ſides and angles the Frame ſtands on. So that you ſee though this projecture ſeem difficult it is eaſily performed on the Ground-plain.

If you would place any thing on the Table at a Deſigned Diſtance from either ſide and end on the Table (as below, which is the ſame with this, only that is ſhadowed, that the lineaments may appear the plainer:) For inſtance upon the edge of the hithermoſt ſide of the Table within ſix inches of the hither end, you would place the Candleſtick; Then imagine the Table to be four foot long, and three foot broad, ſo ſhall each Square on the Ground-plain of the Table repreſent ſix inches. Therefore count to the end of the firſt Square as to the point 1, and there erect a Perperdicular, and where that Perpendicular cuts the edge of the Table ſhall be the place of the Candleſtick. Again, If you would place the hither edge of the Bottom of the Beker within two foot three inches of the hither end of the Table, and within one foot of the hither edge of the ſide of the Table, then count in the row of figures that runs up on the right hand 1 2 3 4 and half one more in the Gound-plain which is two foot three inches, and from that point erect a Perpendicular into the Leaf of the Table: then count in the line of figures that runs down on the left hand from the point 6 to 4 which is one foot and erect a Perpendicular from that point up to the edge of the Table and draw a Diagonal from that point and the point *a* on the right hand, and where that interſects the Perpendicular erected on the point of 4½ ſhall be the point where the middle of the hither edge of the Beker ſhall ſtand. If you would incompaſs that point in the ends of the Legs of the Table which appear through the Leaf, you may work as follows in this next example.

Count from the point *b* to the point 1, which is one Square of the Ground-plain, and the point where one Angle of the Leg is placed, and from that point 1 erect a Perpendicular into the ſide of the Leaf of the Table, as at 1, and from the line *a* on the left hand draw a line to that point for the bounds of the fore ſide of the two fore Legs: Then becauſe the Legs are one Square, viz. ſix inches every way, erect another

ther Perpendicular on the point 2 to the point 2 on the edge of the Leaf, and to that point draw another line from the point *a* on the left hand, and that line shall bound the hind side of the fore Legs; Then erect Perpendiculars from the angles of the Legs; And to the points where these Perpendiculars cut the former lines draw other lines from the point *a* on the right hand; and the lines drawn from the points *aa* on either hand shall bound the top of the Legs: As you may see in the Figure. Do the like when you describe the hind Legs.

## OPERATION XLII.

### *To describe a* Press *with its corners towards the Ey.*

THis Press is placed on a Ground-plain of Diagonal Squares, made as by Operat. XVI. with its angles towards the Base. Its undermost Planck contains eleven Squares in length and nine in bredth, and projects over its Frame on every side one Square: so that the Frame stands upon nine Squares in length and seven in bredth, and in thickness one Square. These Legs are to be erected perpendicularly up into the under Planck of the Press, as the Legs of the fore-going Table were into the Leaf: And this Planck is also made as the Leaf in the fore-going Table. The lines representing the sides of the Plancks, the Rails in the Frame &c. are all drawn from the two points of Distance *aa* on the right and left hand, as you have already been taught.

For placing the Screw in the middle of the upper Planck, Draw from the four angles of the upper Planck *bcde* two Diagonal lines, and where they cross each other is the middle point of the Planck, in which the Toe of the Screw is to be fitted. This Screw is erected perpendicularly into the Rail wherein the Nut is made. The Cheeks *ff*, *gg*, contain each one Square, and are also perpendicularly erected.

## OPERATION XLIII.

### *To describe a* Frame *with four* Posts *and three* Shelves *therein, a* Chair, *a* Door, *a* Thorow-fare, *and two* Holes *in a Wall.*

THis Frame stands with its angles against the Base upon seven Squares one way, and six the other. It is Railed round the bottom, and hath one Shelf below the Horizon and two above it. The manner of making it hath sufficiently been taught in the foregoing *Operat.* viz. The Posts are Perpendiculars erected on the Ground-plain; and the Rails, Shelves, &c. are all drawn from the points of Distance *aa* on the right and left hand. The Shelves you must note do not project over, but run range with the out sides of the upright Posts.

The

The Chair contains in the bottom four Squares each way, as you may see in the Ground-plain. The making the Chair hath already been taught in *Operat.* XXXV. Only the sight of this Chair is changed, for the Legs are placed against the Base. For finding the middle of the Back of the Chair, in order to making the peak in the upper Rail behind, draw from the points *b e* and *d e* two lines, and where they cross each other, draw a Perpendicular through the whole Back of the Chair, and that Perpendicular shall be the middle between the Back posts of the Chair, to which point you must draw up the Peak.

On the left hand you have the Frame of a Door described standing on four Squares in the Ground-plain. The thickness of the Frame is one of those Squares: It is easie to be understood by the Figure alone.

Above the Frame of the Door you have a four-square Hole described, with one of its Angles downwards, which is two Squares high and two Squares broad: Therefore from the point 2 in the Ground-plain erect a Perpendicular, and on that Perpendicular designe what height the lower Angle of the Hole shall stand at above the Door, as here at *f*, then draw a Visual line through the point *f* into the said line of the Figure as to *g*, and from the point *g* set off four devisions of the Base upwards, as 1 2 3 4, and draw another Visual line through the Perpendicular into the point 4, and where the Visual line cuts the Perpendicular, as here at *h*, shall be the upper Angle of the Square Hole; Then erect two Perpendiculars one from the point *o*, the other from the point 4 in the Ground-plain, and where these Perpendiculars cut the Visual line *i 2*, as here in the points *k l*, shall be the other two opposite Angular points of the square Hole; and straight lines drawn from *f* to *l*, from *l* to *h*, from *h* to *k*, and from *k* to *f*, shall include the fore-side of this square Hole. The back side may be easily apprehended by the prickt lines behind the Figure. If you would find the middle of this square Hole, draw lines from each two opposite Angles, as from *f* to *h*, and from *k* to *l*, and where they cut each other shall be the middle of the Hole.

On the right hand over a thorow-fare is described another square Hole, with one of its sides downwards, containing also two Squares on each side. To make this, erect a Perpendicular on the point 2 in the Ground-plain on your right hand, and on that Perpendicular designe the height of the under side of your Hole, as at *m*, and through that point *m* draw a Visual line into the side-line as at *o*, from which point *o* set off two devisions (as afore said) of the Base upwards, as at *o 2*, then erect another Perpendicular as at *o* in the Ground-plain through the Visual line, at the point *n*, and so much of the Visual line as is contained between the points *m n* shall be the under side of the square Hole; then draw another Visual line from the point 2 on the side-line, and so much of that Visual line as is contained between the two Perpendiculars *o n p* and 2 *m q*, viz. *p q* shall be the upper side of the Hole. The other two sides are the Perpendiculars *p m* and *q m*: By the Parallels *q r*, *m s*, *p t*, and *n v*, you have the thickness of the said Hole, viz. one Square, as in the Ground.

## OPERATION XLIIII. XLV.

### To Delineate the Scenographick Plat-form of Buildings, in order to the true Deſcribing of Houſes, or other Buildings in Landskips.

THis Geometrick Ground-plot is reduced to Scenographie by the Rules you where taught in ſeveral foregoing *Operations*; whether I refer you. But if it be required that you make the Ceeling of the ſame form the Ground-plot is, you muſt erect Perpendiculars to your deſigned Height from the ſeveral Angles of the Scenographick Ground-plot, and Viſual raies drawn from the point *a* by the interſection of Diagonals drawn from the points *b b* ſhall inſcribe the Roof or Ceeling alſo, (as you were taught in *Operat.* XXV. XXVI. XXVII. &c.

It will in ſome Caſes be convenient to take the lines *c c* or *d d* for the Baſe; and then you will have the Ground-plot and Ceeling for the ſides: By which means you may eaſily make Holes through Walls, or deſcribe Loggs lying croſs one another, &c.

## OPERATION XLVI.

### To erect a Building on the firſt Ichnographie of the former Leaf.

THe former Ichnographies are deſcribed in this Plate: And what is hid by the Structure raiſed thereon is marked with prickt lines, as you may ſee the Scenographick Squares marked 1 2 3 4 5, in Fig. XLII. whereon the four Pavilions and the Steeple are perpendicularly erected to a convenient height. Here you may ſee that Ranges on the fore-right ſides are parallels to the Baſe and Horizon, and the Ranges on the right angled Return ſides are drawn from the Viſual point: and the cut off angles (which we muſt alſo call ſides) are drawn from the points of Diſtance. As in the Octangular Structure, Operat. XXVII.

## OPERATION XLVII.

### To erect a Building on the ſecond Ichnographie of the former Leaf.

THis Pyramidal Spire ſtands upon four Pedeſtals, and hath the middle of its top found in the Ichnographie, as at *b*, by erecting a Perpendicular from that point: and the reſt of its ſides are made by erecting Perpendiculars into the ſurface of the

the Pedestal, and from thence carried up towards the top of the Spire. The shortning both of the Sides of the Pedestal and Spire are drawn from the Visual point. As you may see in the Figure.

## *OPERATION.* XLVIII.

### *To delineate the appearence of Buildings, in order to the truer drawing of Landskips.*

BEfore we treat of Landskips it will be necessary to begin with Houses in several positions, viz. with their Sides in Orthographie, and Front in Scenographie: As the Figures A C D: And with the Front in Orthographie, and Sides in Scenographie: As the Figure B, and several others already described in this Book represent: with the several appendices belonging to Houses, as Steps, at *a*; Penthouses, at *b*; opened Windows, as at *c*; Jetties, as at *d*; Buttresses, as at *e*; Bridges, as at *f*; &c, all which may meerly by considering the prickt lines, and whence they proceed, be understood. As for Example. To find the middle Perpendicular line of the Front in Fig. A. in order to the ridge of the Front in the middle, as at *g*: Continue the Perpendiculars *h h* and *i i* to a convenient height, and draw two Visual raies at what distance you please through them, as here the Visual raies *i* and *k*, and from the points where the Visual raies cut the Perpendiculars, draw two straight lines corner-wise, as *h k*, *l i*; and the intersection of these two lines shall be the middle of the Front between the two Sides, and a Perpendicular erected on that intersection through the top of the Front shall be the line the Ridge must be placed in: as is shewn by the Figure. The arch of the Bridge at *f* is drawn from the two centers *m n*.

The finding the middle line in the House C is otherwise performed, for this House is covered with a Spire whose four sides falls into the middle of its Ichnographie; Therefore to place it right you must have the middle of the Ichnographie it stands upon: as here, the sides *o q*, *q r*, *r p*, *p o*, for then lines drawn from the two cross corners shall intersect each other in the middle of the Ichnographie, and a Perpendicular erected shall shew the middle of the Spire, as at *s*; And straight lines drawn from the top-corners of the Building shall include the Spire.

But if you will have a Ridge-cover to this Building, the Ridge must ly in the middle of the Orthographie, as here at *t v*, and straight lines drawn from the two Orthogtaphick sides *o p* to the point *t* shall make the fore-point of the Ridge.

Here is also a Draw-Bridge described, where the prickt arch *x y* shews the arch it describes in drawing up. But all the Scenographie of this Projection being made from the Visual point, become so easie that I need make no more words on it.

These Structures are placed just on the surface of a Water, Because a flat Ground should appear about them. The Scituation of the Figure may be easily understood by the Visual point, and point of Distance *z*.

## OPERATION XLIX.

### *Of Landskips in general: How they must be ordered.*

IN the first place you are to observe for a Rule, That if in your Landskip you have any standing Water (as a River, a Pond, &c. to describe, you place your Horizontal line level with the farthest sight or appearence of it; as in this Figure: where the Visual point placed in the Horizon is at *a* in the Water.

2. If any Houses or Cottages happen in your Picture, you well consider their position, that you may the better find from what point in the Horizontal line to draw the Front and Sides of those Houses, &c. As you shall be taught in the next Operation.

3. That when you describe any thing at a great distance, you make it rather too big than too little, that you may the better accommodate your Picture to the sight and understanding of the Vulgar.

4. For Trees, Hedges, Shrubs, &c. you are left to your discretion, for making them either slender or stubbed, thick or thin of Leaves, &c. because it would be endless in drawing them by proportion; partly for the multiplicity of parts in every Tree, &c. and partly because the season of the year alters their appearance.

5. In Colouring and shadowing, Those Objects that ly neer the Ey, you are to make of the same Couloure in your Picture they are in the Object: only as they run from the Ey they must be made fainter and fainter, till at last they all loose themselves in a dark Sky Couloure.

## OPERATION L.

### *To draw* Buildings *that are posited obliquely to the* Horizontal line.

PLace your Geometrick Ichnographie in what position you think good, as here A B C D, which reduce to Scenographic, as by many of the foregoing *Operations*, and as here you find them at a b c d, then on the corners of these Scenographick Ichnographies erect Perpendiculars for the several corners of your Buildings, as in *Figure A* erect the Perpendiculars *A a*, *b c*, and draw a line through the points *A b* into the Horizon, as at *d*, for the Ground-line of that side of that House, so shall all lines that are on that side of that House Parallel to the Ground-line be drawn from that point *d*; as the lines *a c* and *a f*: thus the Return sides of *A b* must be drawn from the point *g* in the Horizontal line, whether (as you may see) the lines of the Ichnographie tend. The like you find in the *Figures B C D*, where in the *Figure B* two sides appear. viz. the sides *B b* and *B i*: from *B b* the line *B h k* draws the Ground-line on the left hand,

hand, and *B i l* the Ground-line on the right hand. In the Houſe *C* the Return ſides are drawn from the point *n* in the Horizontal line. And for the Houſe *D*, the lines *D o* and *D p* prolonged into the Horizontal line, as at *q r*, delineates thoſe ſides, and all lines that in the Structure are Parallel to thoſe ſides: as you may ſee in the lines *r r*, &c.

## OPERATION LI.

### *Shewing how to repreſent Shadows of* Bodies.

SHadows are made by the poſition of Opacous Bodies before Luminous Bodies, which Opacous Bodies ſtop and hinder thoſe Lines of Light which elſe would paſs from the Body of Light to the Plain whereon the Opacous Body ſtands.

By Lines of Light, I mean thoſe ſtraight lines that paſs from the Body of Light to the Plain. Thus the line *a b* is a Line of Light.

Theſe Lines of Light, the Plain or Line of Saddows, and a Perpendicular let fall from the Body of Light makes alwaies a Triangle, as is the Triangle *a b c*, where *a b* repreſents the Line of Light *e b* the Plain or Ground-line of Shaddows, and *a e* the Perpendicular.

If in this Triangle any Opacous Body be placed ſo as to break the lines of Light, that opacous cauſes a Shadow: Thus the Staf *d e* erected perpendicularly at *d* breaks all the lines of Light incloſed between *d e b*, and makes the Shadow *d b*: by which inſtance alone you may ſee the manner and properties of Lines of Light; and how a ſtraight line drawn from the line of Shadows through the point the Opacous body ſtands on, and a line of Light drawn from the body of Light through the top-point of that opacous body ſhall cut each other in the point of termination of Shadow. By this propoſed Staf I would have you underſtand a Line, though in this place it would be unproper to call it ſo, becauſe that having no Geometrick bredth makes no ſhadow. But as was ſaid in the third Operation, where a Line was laid down in Perſpective, knowing how to draw a Line in Perſpective you know how to draw all Figures, becauſe they are bounded by Lines; ſo I may ſay in Shadows, for though the Object be a Body, yet the Shadow is but a Figure, and by knowing how to draw the Shadow of every Line properly you know how to draw the whole figure of Shadow. As you may ſee in this next Operation.

## OPERATION LII.

### *To find the Shadow of a Cube, the elevation of Light above the Ground-point being aſſigned.*

THe given Light is *a*, the Ground-point *b*, the Cube *c d e f, g h i k*, Therefore from the upper angles of the Cube *c d e f*, I draw lines of Light through the Plain, and from the point *b* I draw lines of Shadow through the under angles of the Cube, as

through *g h i k*, and where these lines of Shadow cut the lines of Light (as here *a e* cuts *b i* in *l*, *a d* cuts *b h* in *m*, *a f* cuts *b k* in *n*) shall be the points that the shadowing angles of this Cube casts its shadow on the Plain, as here to *l m n*, and straight lines drawn from *m* to *l*, from *l* to *n*, from *n* to *k*, and from *m* to the side of the Cube *g c* shall include the shadow.

## OPERATION LIII.

### *To find the shadow of a Cilinder, the elevation of the Light above the Plain of shadow being given.*

THe Body of Light is *a*, the Ground-point *b*, the Cilinder *c d e f, g h i k*: The Cilindrick section above the plain of Shadows you must bring into the Plain of Shadows, by letting fall Perpendiculars from the four devisions above, viz. *c d e f*, into the the plain of Shadow, as at *l m n o*: Then by drawing lines from the body of Light through the devisions in the upper end of the Cilinder, as through *c d e f*; and from the points *g* through *l*, *k* through *o*, *i* through *n*, and *b* through *m*; where the lines of Light cut the lines of Shadow, as here in the points *p q r*, shall be the bounds of a Scenographick arch, which joyned to the straight lines *h p* and *k r* shall include the shadow.

You must note, That the Scenographick Figures *c d e f*, made at the top of this Cilinder, and *l m n o*, made by the Perpendiculars let fall into the Ground are true Scenographick Circles; and that the circle *c d e f* appears smaller than the Circle *l m n o*, because it is posited neerer the Horizontal line, which alters the Scenographick appearance: as you may see in the several Circles that are made about the Newel of the Winding Stairs, in Operat. XXXIII. This I mind you of, because from the devisions in that Circle, and not from the Ground-point, the lines of Shadow are drawn to cut the lines of Light.

## OPERATION LIIII.

### *To find the shadow of a Cone set on its point, the elevation of Light being given.*

THe Body of Light is *a*, The Ground-point *b*, the Cone *c d e f g*, Project the top of this Cone (which is a Circle) Scenographically, as in Operat. IX. X. and by Perpendiculars let fall on the Ground, draw also the other Circle *h i k l* from the same Visual point, and point of Distance: Then from the Body of Light draw lines into the Ground, through the points *d e f g* of the upper Circle, and from the Ground point draw lines through the points *h i k l*, in the Circle on the Ground; and where these lines intersect each other, as here in the points *m n o*, shall be the points through which the Scenographick arch *m n o* drawn to meet the straight lines *i m*, *l n*, and *k o*, shall be the track that shall include the shadow.

OPERAT-

## OPERATION LV.

### *To find the shadow of a Tetrahedron with one of its points set on the Ground, the elevation of Light being assigned.*

THe given Light is *a*, the Ground-point *b*, the angles of the Tetrahedron *c d e f*; Project the Triangle *c d e* Scenographically on the Ground, by Perpendiculars let fall from the angles, as into *g h i*, and let the length of the Perpendicular *e f* be the length of the Side *c d*; so shall the sides *g h*, and *h i*. be drawn from the same point in the Horizontal line that the lines *c e* and *e d* were drawn from. Then from the body of Light draw lines into the Ground, through the points *c d e*; and from the Ground-point draw lines through the points *g h i*; and where these lines intersect each other, as here in the points *k l m*, draw straight lines from *f* to *k*, from *k* to *l*, and from *l* to the side *d f* of the Tetrahedron, where it is cut by the prickt line *m n*.

## OPERATION LVI.

### *To find the Shadow of a Staff broken by the interposition of a* Parallellepippedon, *and by the interposition of a* Cilinder. *The Elevation of Light being assigned.*

THe Body of Light is *a*, the Ground-point *b*, the Staff *c*, by working as by *Operat.* LI. you find a straight shadow continued from *d e*, where the shadow breaks against the Parallellepippedon, and and rises Perpendicularly on the side *e f*, and thence on the upper side of the Parallellepippedon continues it self Parallel to the Plain of Shadows as at *g*, and so looses it self behind the further side of the Parallellepippedon.

But the Saff *h i* makes another fashioned Shadow on the surface of a Cilinder; for by working as before, you find the shadow of the Staf continue straight from *i* to *m*, where the interposition of the Cilinder breaks the shadow, by receiving it on its own surface in the form of a Scenographick Semi-circle, which is the Figure the Circumference of this Cilinder would make, if it were cut asunder in *m n*.

## OPERATION LVII.

*To draw a Figure which on the Plain ſhall be deformed: yet when ſeen from a deſigned point through a Hole ſhall ſhew a Comely and proportionable ſhape.*

MAke a Plain of ſo many equal parts as you pleaſe, as is the firſt Plain *A B C D*, which is devided into 8 in length, and 8 in depth, as you may ſee markt down the ſide and bottom with 1 2 3 to 8, and therein draw what you think good: as in the ſecond Plain A B C D. Then make an other Plain of as many unequal parts as is the third Plain *c a d b*, (and mark two ſides of that alſo with 1 2 3 to 8.) Thus, Set off one ſide of your firſt Plain *A B C D* at *d b* of the third Plain, and in the middle of it as at *e*, erect a Perpendicular as at *e 4 f*, which point *f* ſhall be the point of Diſtance: from this point of Diſtance draw two ſtraight lines as *f e d*, and *f a b*: then ſet off your intended height from the point of Diſtance, as *f g*, and draw the Diagonal line *g c b* to the point *b*, and where this Diagonal cuts the out line *f e d*, as here at *c*, draw the line *c a* Parallel to *d b*, ſo is the four ſides of your third Plain made. To divide this into ſmal ſquares as your firſt Plain is, do thus, Devide the line *d b* into 8 equal parts, as 1 2 3 to 8: then lay a ſtraight Ruler to the point of Diſtance *f*, and to every one of theſe deviſions ſucceſſively, and by the ſide of it draw lines from the line *c a* to theſe deviſions, and theſe lines ſhall repreſent the Perpendiculars in the firſt Plain: Then from the points where theſe Perpendiculars cut the Diagonal *g c b* draw lines Parallel to the lines *c a* and *d b*, and theſe lines ſhall repreſent the thwart lines that cut the Perpendiculars in the firſt Plain.

Having thus projected your Plain, drawn therein the figure that was drawn in your ſecond Plain; and be carefull to draw every ſtroak thereof in its reſponding Square and part of the Square, with the ſame proportion to each of theſe Squares that you find in the ſquares of the ſecond Plain. And though the figure ſeem when drawn very diſtorted and unproportionable, as in the fourth Plain *a b c d*, yet if you place one of your Eys directly over the point *f* at the height of the line *f g*, and winck with the other Ey, you ſhall ſee (if your figure be exactly drawn) the perfect ſhape of the figure in the ſecond Plain. But that you may the better underſtand me I have paſted a thin Paſt-board on the line *h f g*, which if you erect perpendicularly, and look through the hole with one of your Eys cloſe to that hole, you may ſee the ſame figure in this fourth Plain that is drawn in the ſecond.

OPERAT.

## OPERATION. LVIII.

### *To draw on a Quadrant a Figure seemingly confused and without Design, yet when of this Quadrant a Cone shall be made, a comely and proportionable Figure shall appear.*

DEscribe a Circle of the bigness you intend the Base of your Cone shall be, as the little Circle 1 2 3 4 &c. to 8, Devide this Circle into so many equal parts as you will(the more the better) this is devided into eight; and from the Center draw straight lines to every one of these devisions, as to 1 2 3. &c. to 8. Then devide one of these Semi-diameters also into eight equal parts, and through every one of those equal parts describe on the Center a circle concentrick to the outmost, as the Circles 1 2 3 to 8. Then to make the appearence of these Lines and Circles on the outside of a Cone, Describe a Quadrant whose Radius shall be twice the Diameter of this Circle, as the Quadrant on the right hand, and continue the under Radius to an extream length. Devide this Quadrant into two equal parts, and devide the lower part into eight equal parts; then erect a Perpendicular on the Base as at 8, and from the Center draw straight lines through the eight devisions aforesaid into the erected Perpendicular. Then placing one foot of your Compasses in the point 8, open the other sucessively to all the intersected points in the Perpendicular, and describe the several arches 1 7, 2 6, 3 5, 4 4, 5 3, 6 2, 7 1, 8 0 Then devide the outmost arch into eight equal parts, as 1 2 3 4 5 6 7 8, and draw straight lines from the Center into each of these equal parts; So shall this Quadrant when cut close by the outmost lines thereof, and rolled up in the form of a Cone, and placed directly before the Ey, so as the light may fall round about it, shew like the little Plain of Circles and straight lines, and be of the same bigness, and all the arches in this Quadrant shall become concentrick circles equi-distant from one another: and the straight lines shall proceed from the center both waies into the circumferance.

Whence (by consequence) it will follow, that what lines soever are drawn in any of the squares of the Plain of Circles, and the same transferred to the Quadrant, in the square responding to that square in the Circle, it must also appear in the Quadrant, when made in a Cone, in the same shape it doth in the Circle, As you may see in the inlarged Circle and Quadrant, wherein a Figure is delineared.

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## *Of Catoptricks or Reflected Beams.*

REflected Beams are seen in a Glass, or other matter curiously polisht. If this Glass or polisht matter be exactly flat the Object appearing in it, is exactly like its Original. This you see in common Looking Glasses: But if the Glass be not

flat the Object alters from the Original, and that more or less according as the Glass is more or less flat, Therefore in drawing Catoptrick Figures you must consider the Shape of the surface of the Glass which you intend to have the Reflection made upon, and for every surface you must make a particular Ichnographical Projection, which must on the Glass appear to be a Plain full of equal Squares: on which Projection if you transfer what shall be drawn on a Plain devided into the same number of true Squares, though in the Projection it shall shew very distorted and confused; yet shall the Reflection thereof on the Glass shew very regular, proportionable, and well composed. I shall give you one Example thereof in this next *Operation.*

## OPERATION LIX.

### *To Draw an Appearance seemingly confused and without design which shall Reflect on a Cilinder Perpendicularly erected in a designed place, an intended Figure.*

SUppose (For Example sake) it be the likeness of the Figure A that is intended to be seen Reflected on a Cilinder. First devide every side of the Figure into so many equal parts as you please (here we will take 12) and draw lines through these devisions to cut each other at right Angles: Then if you make a Projection whose Reflection on a Cilinder shall shew the same shape and number of Squares: It follows by consequence that if you transfer all the Lineaments in the Figure, A to this Projection, and place every Lineament in its proper scituation so as to correspond with the same space from the top and sides of this Plain, every one of these Lineaments in the Projection shall also appear in the Cilinder in the same shape and scituation they do in the Square Plain.

Therefore to make this Projection, describe on the Center *a* the Circle *b 4 c d*, of the same Diameter you intend the Cilinder shall be, suppose about an Inch and an half; devide the Semidiameter of this Circle into 4 equal parts, as 1, 2, 3, 4, then on the devision at 3 place one foot of your Compasses and extend the other to what width you intend your outmost Circle should be, as here to *e*, and describe the Circle *f e g*: Then devide one of those parts of the square Plain into 20 equal parts or sub-devisions, and make the first devision from *e*, 6 of those equal parts or sub-devisions bigger than one Square, which you must set off on the Diametral line from *e* towards *a*; the second from *e*, 5 of those sub-devisions bigger than a Square which also set off from *e* towards *a*, the third 4, the fourth 3, the fifth 2, the sixth 1, and the seventh equal: the eighth 1 sub-devision less than a Square, the ninth 2 less, the tenth 3, the eleventh 4, the twelfth 5 sub-devisions less than a Square, which successively set off from *e* towards *a*: then on the

Center

Center at 3 (aforesaid) place one foot of your Compasses and extend the other successively to each of the devisions set off on the Diametral line, and through every one of those devisions describe so much of a Circle as the Plain will bear, so shall all these arches of Circles represent those straight lines in the Plain square A that run athwart the Plain from the left hand to the right, and reflected on the Cilinder they shall become straight lines parallel to each other.

To represent in this Projection the Perpendiculars on the Plain square, you may on the Center *a* describe an occult Circle as large as you can within the Projection, as the Circle *h i k l*, devide half of this Circle as *k g h* into 8 equal parts, and through every one of these equal parts draw lines from the Center *a* into the Circumference of the Projection, and these lines shall represent 8 Perpendiculars on the Plain square. To draw the other 4 transfer the distance of one of the devisions in the Circle *h i k l* twice from *l* towards *k*, and twice from *i* towards *k*, and draw straight lines (as before) through these distances into the Circumference of the Projection: so shall the whole Projection be finisht.

Note that in this Projection the whole Circle is not devided into 12 equal parts, but only three quarters thereof, because the Cilinder will not well gather in more raies, for the other quarter lies hid behind the Cilinder.

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## *Of Dioptricks or Broken Beams.*

THe Broken beam is to be seen in a Tube, through a Christal or Glass that hath its surface cut into many Faces: as is the Fig. *A*: for every one of these Faces making Angles with the Base or Flat side of the Christal shew an Object each as through its own Face and not through the Flat of the Christal: And so is said to break the Raies of an Object: because to the Flat of the Christal the Raies run straight, but afterwards they break into the same Angle the Face on the other side of the Flat makes with the Flat.

Thus it comes to pass that when these Faces on the Christal are turned towards a Plain placed directly before it, these Faces of the Christal dis-sever themselves at a considerable distance on the Plain, because they are all directed to several remote parts of that Plain.

Now though there hath not as yet been any Geometrick Rule found for the assigning a place on the Plain of each of these Faces, yet is there found how they may be placed on a Plain; as you shall learn by the next *Operation*.

## OPERATION LX.

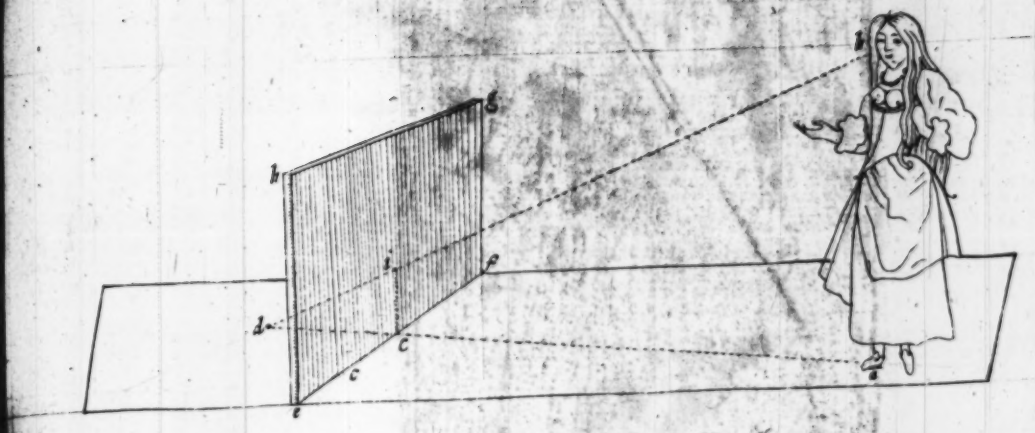
### *How among a great many Pictures on the Plain, to see one elected and peculiar Picture quite different from any on the Plain.*

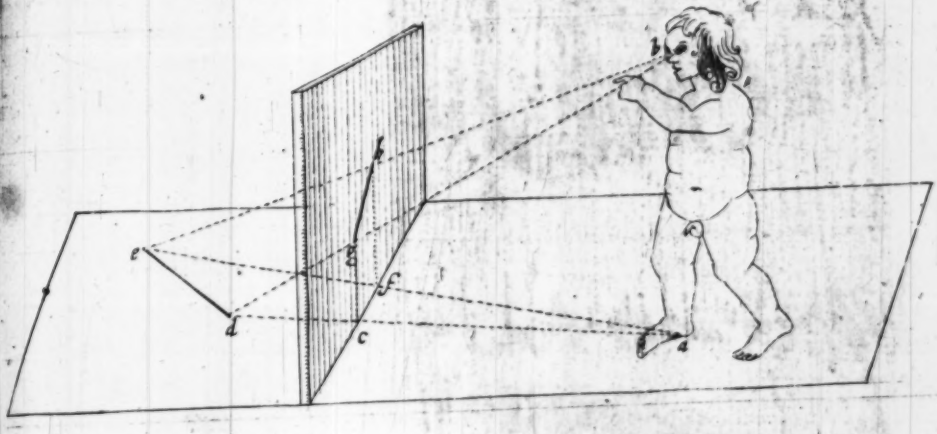
HAving fixed your Plain fast, and also fixed your Tube fast directly before the Plain; look through the little Hole at the hither end of the Tube, and with a point or black-lead pencil mark where the several Angles of each and every Face of the Christal falls upon the Plain; so may you with your black-lead pencil draw a line by the side of a Ruler from point to point of each Face thus found on your Plain. But you must remember to mark each Face on your Plain with numerical figures or some other mark, so as you may know to what Face of your Christal each belongs: for you will find them all reverted; that is those seen through the top-faces of your Christal will be in the bottom of your Plain: and those seen through the right hand Faces of your Christal will be on the left hand on your Plain.

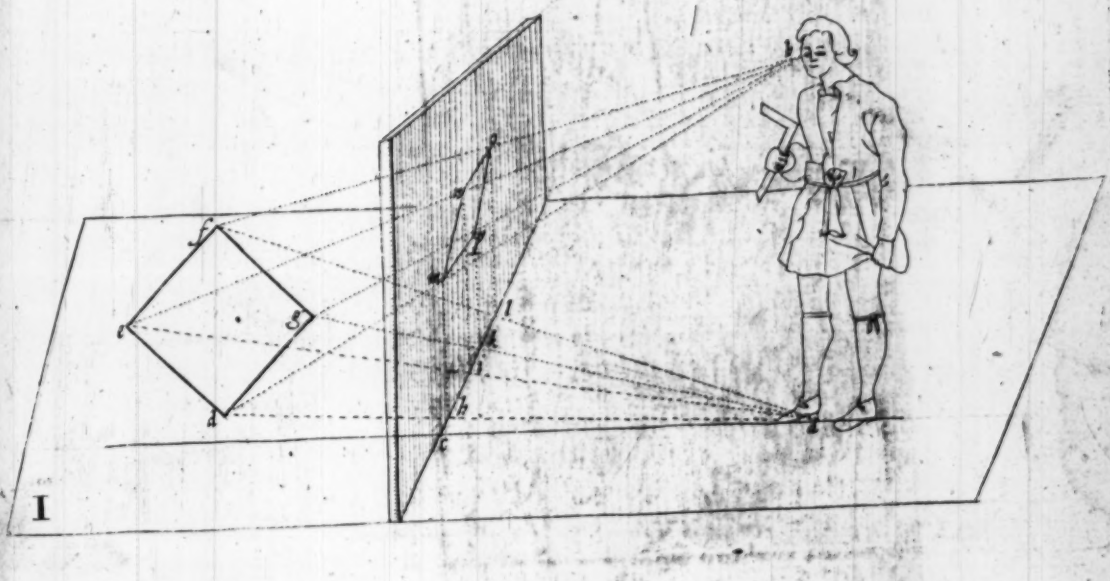
Having thus prepared your Plain, you must draw the figure of your Christal (on a plain paper) exactly of the size of your Christal, and devide it into so many parts your Christal is devided and cut into Faces; and mark each devision thereon in a reverted order from that on your Plain: As if the bottom Face on your Plain be marked 1, then mark the top-Face in your paper 1; And if 2, 3, 4, &c. be marked towards the right hand on your Plain mark them towards your left hand on your paper; as you see in the Figure. On this paper therefore you must draw the Picture you intend shall be seen on the Plain: Suppose the Picture of King *Charles* the first: and having drawn it, transfer all the lineaments and streaks you find in each respective Face on the paper to the responding Face on the Plain. As for example: What lineaments you find in the Face marked 1 on the paper, transfer to the Face marked 1 on the Plain: what lineaments you find in the Face marked 2 on the paper, transfer to the Face marked 2 on the Plain. And so for all the rest.

Then looking again through your Tube, you will see all the severed Faces on the Plain unite, each Face contributing the lineaments drawn in it to form your intended Picture of.

If you have a mind further to amuse Spectators, you may to every one of the Faces on the Plain draw another Picture: as in the Face marked 10 on the Plain you find an Ey, to this Ey make up an whole Figure; To the Face marked 12 you find the Mouth, to this make up another whole Figure &c. But you may alter the likeness as much as you list, both in countenance and dress: So will the conceit appear yet so much the stranger. I have inserted one Example, where about the Face 1 on the Plain, I have set the Picture of a Woman.

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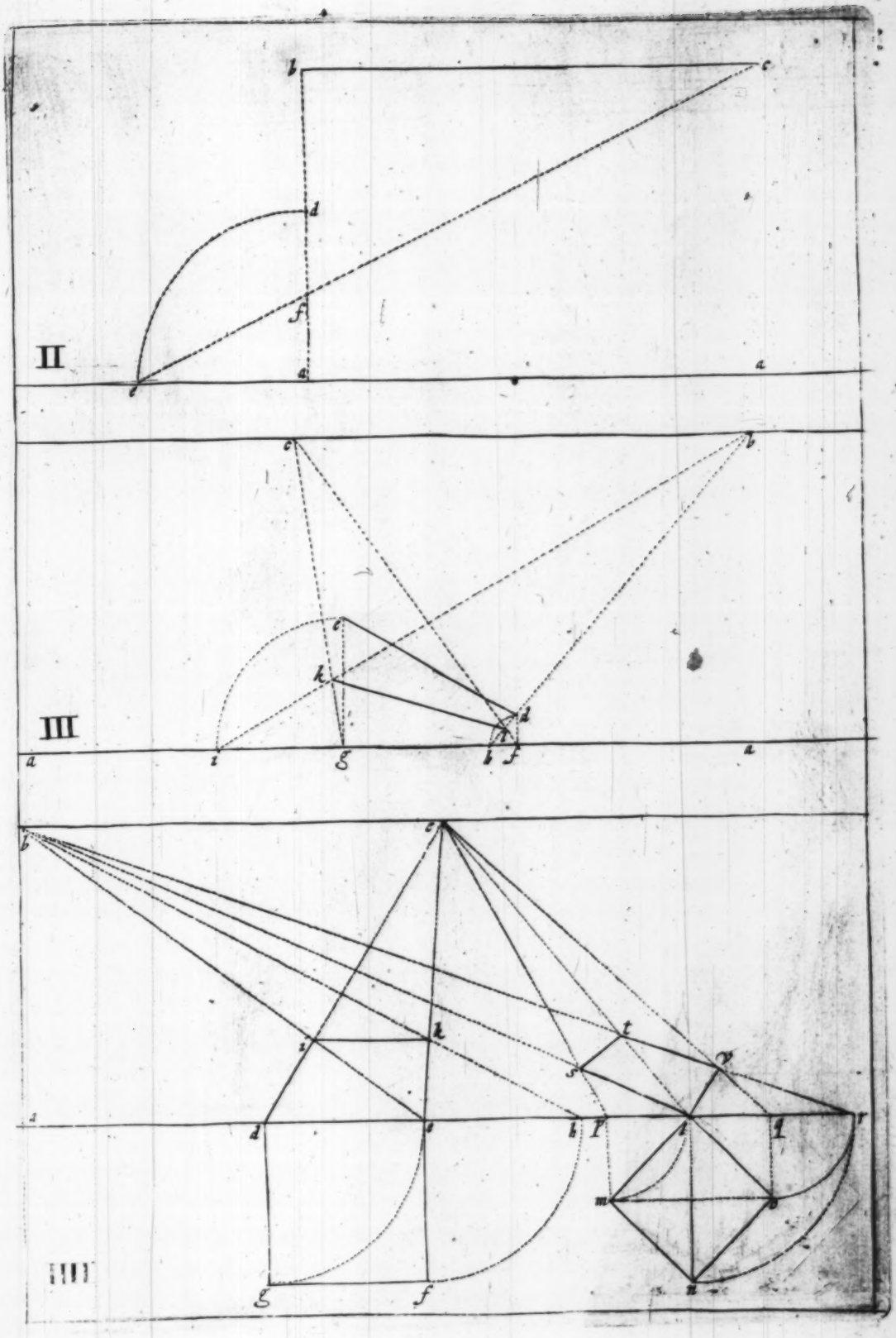
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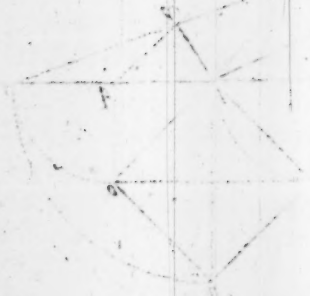

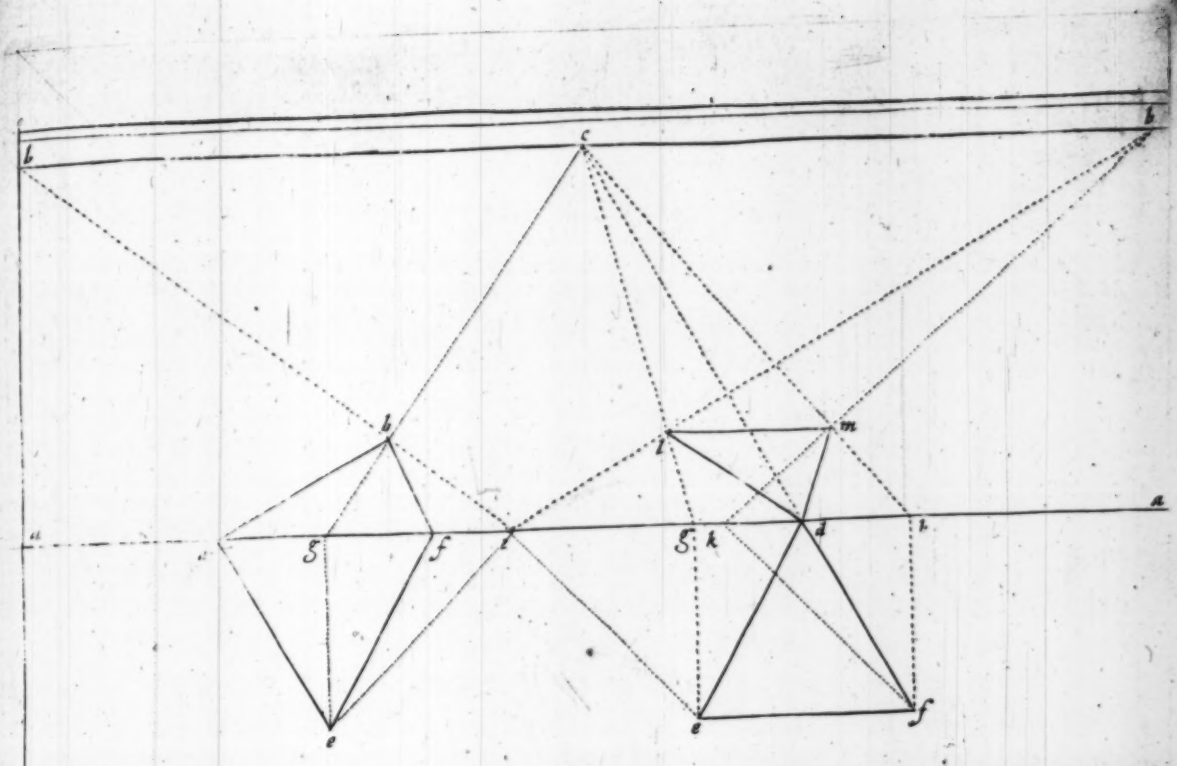


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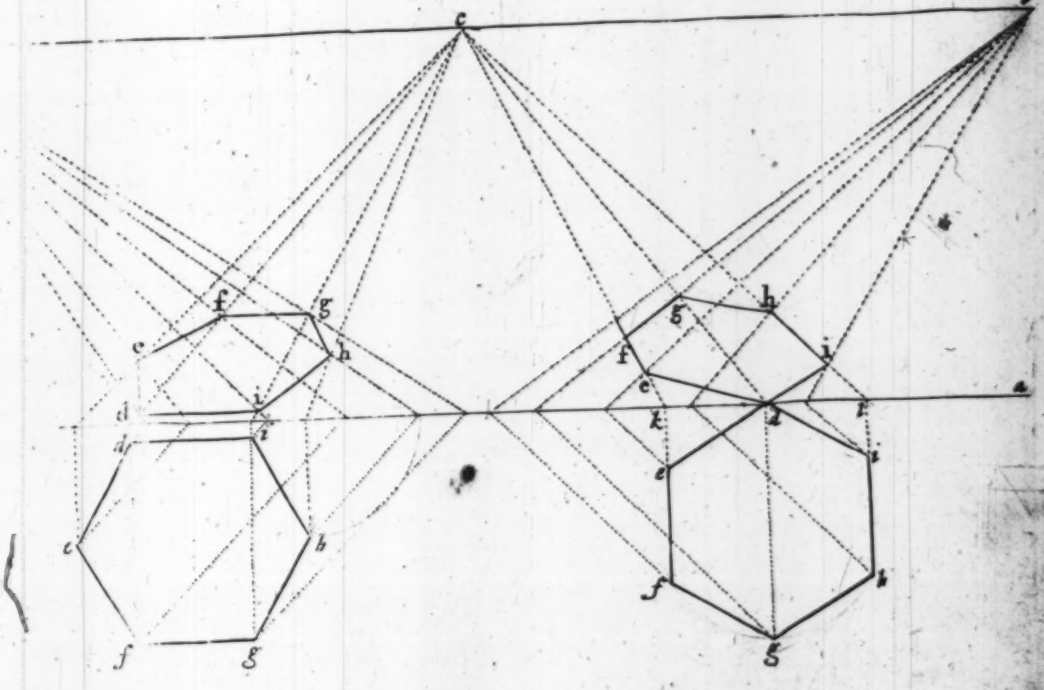


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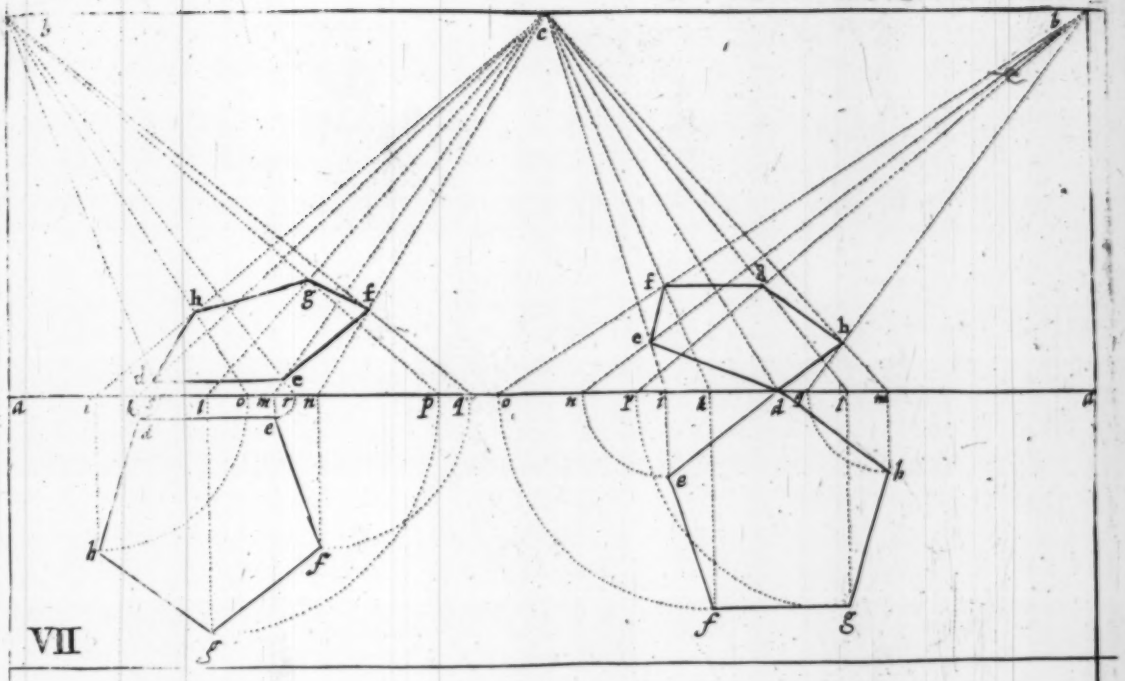
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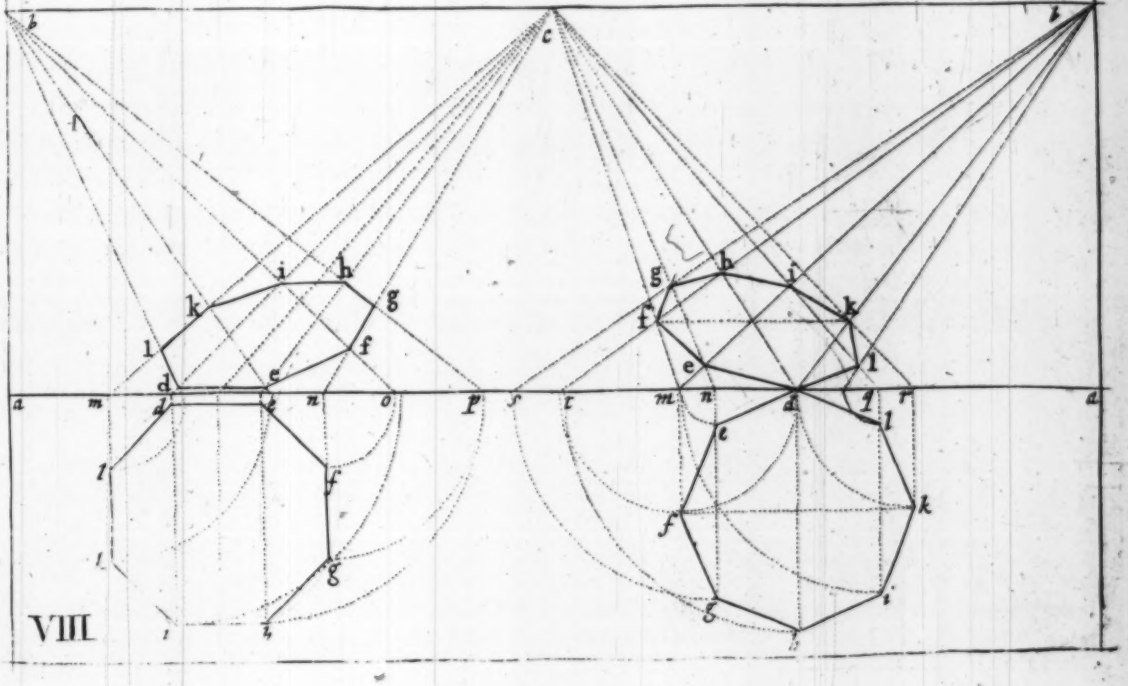
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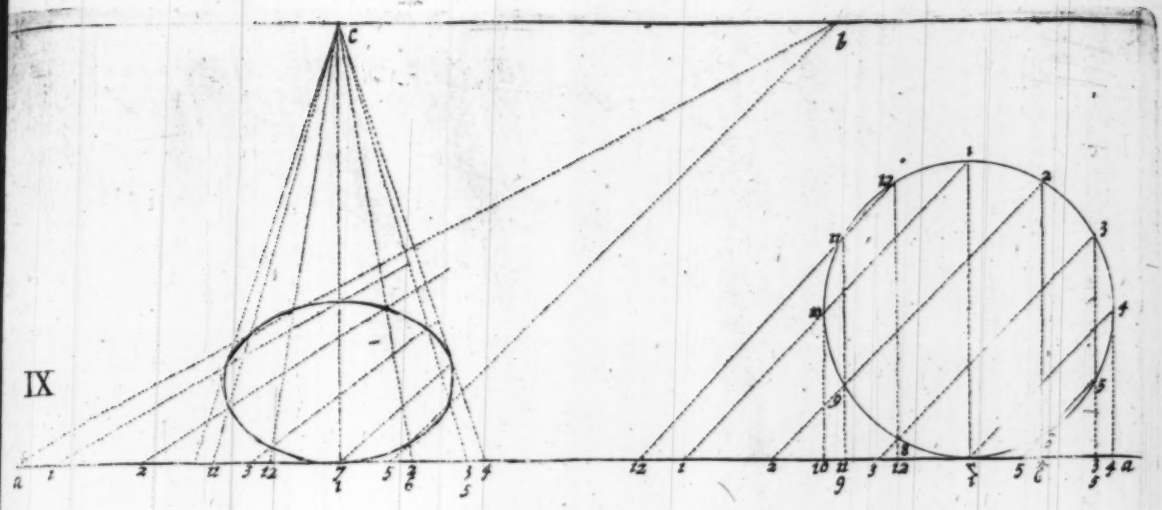
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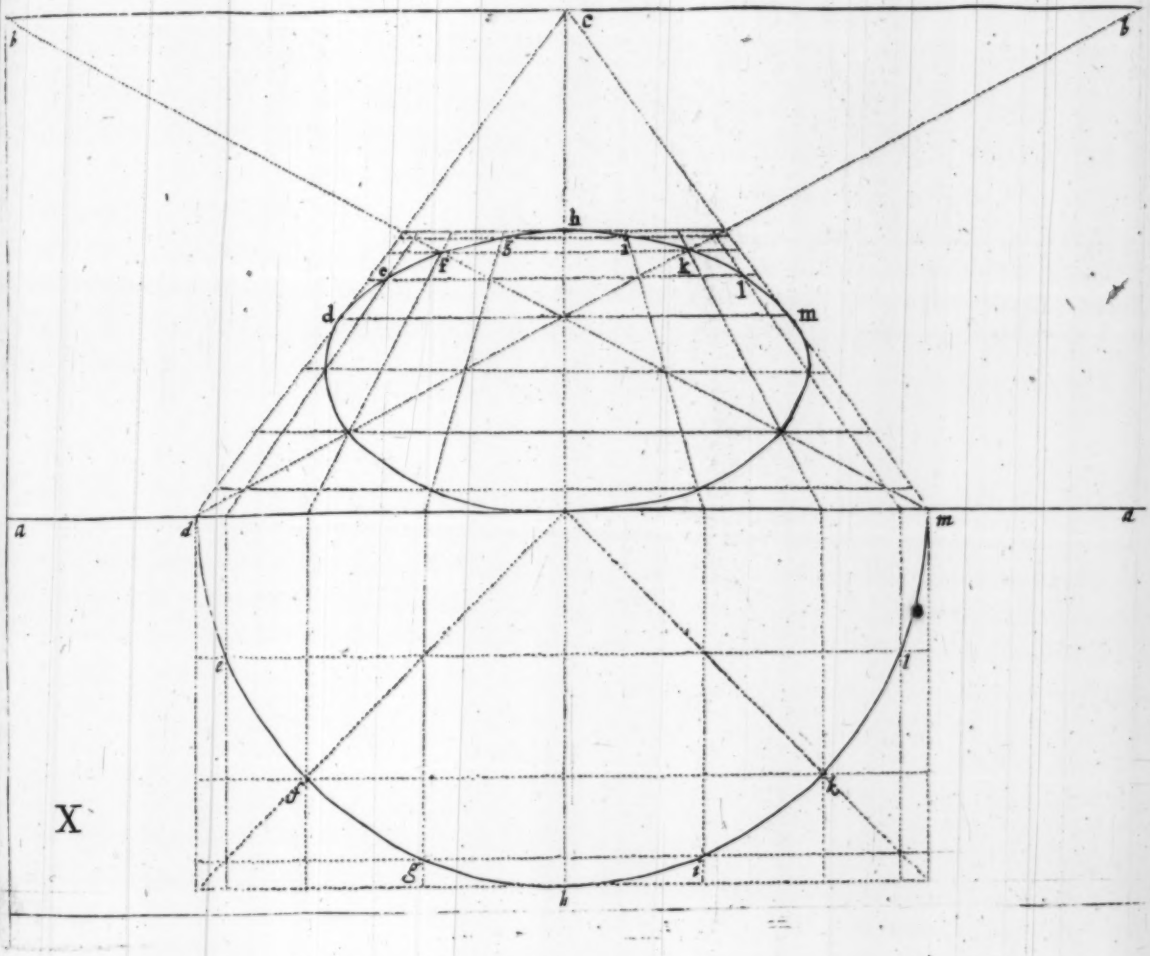
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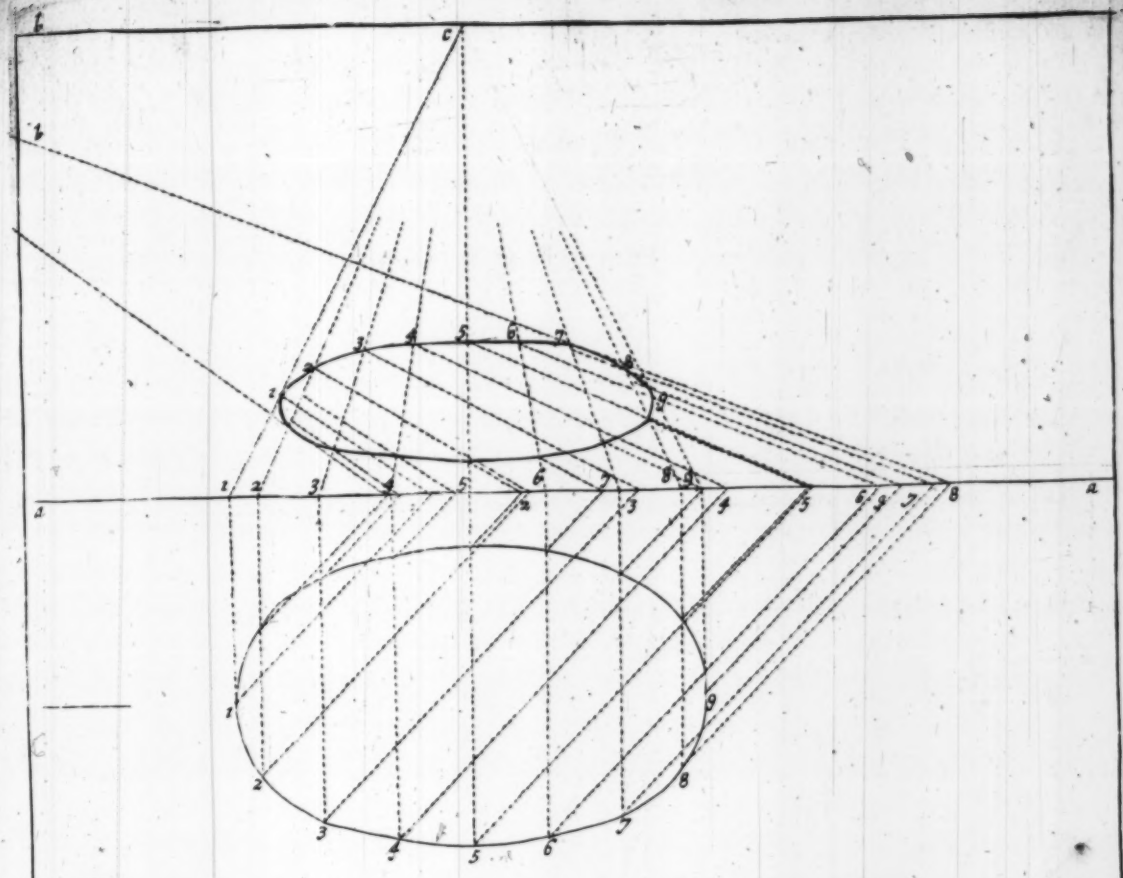


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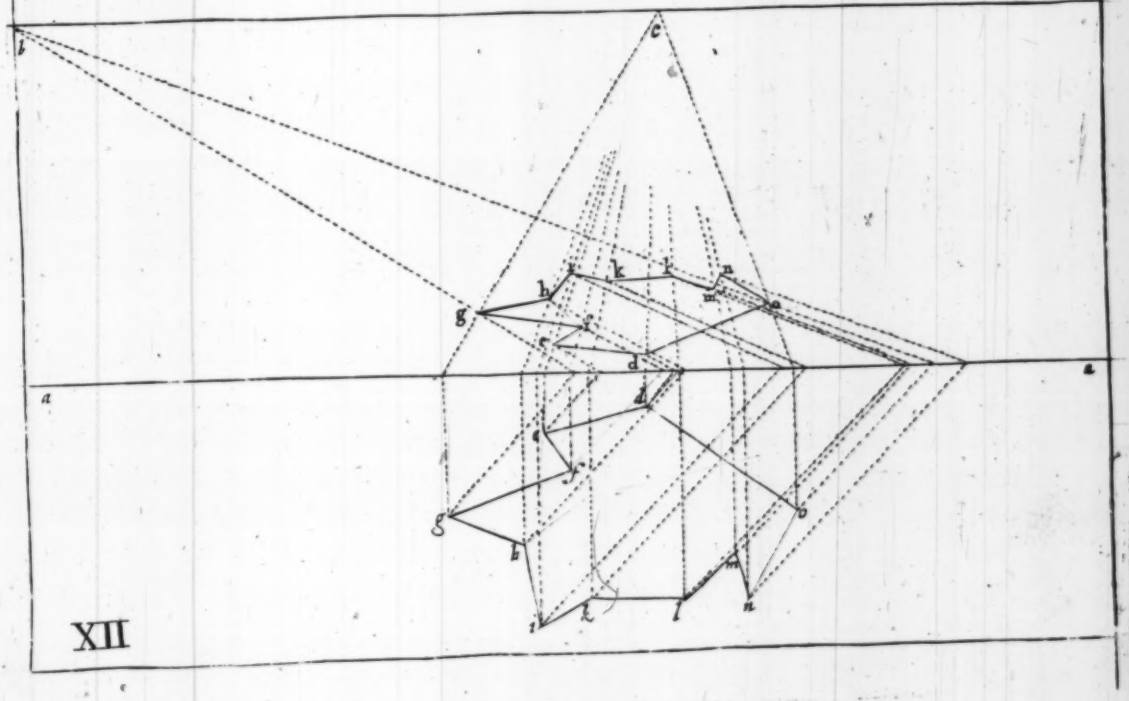


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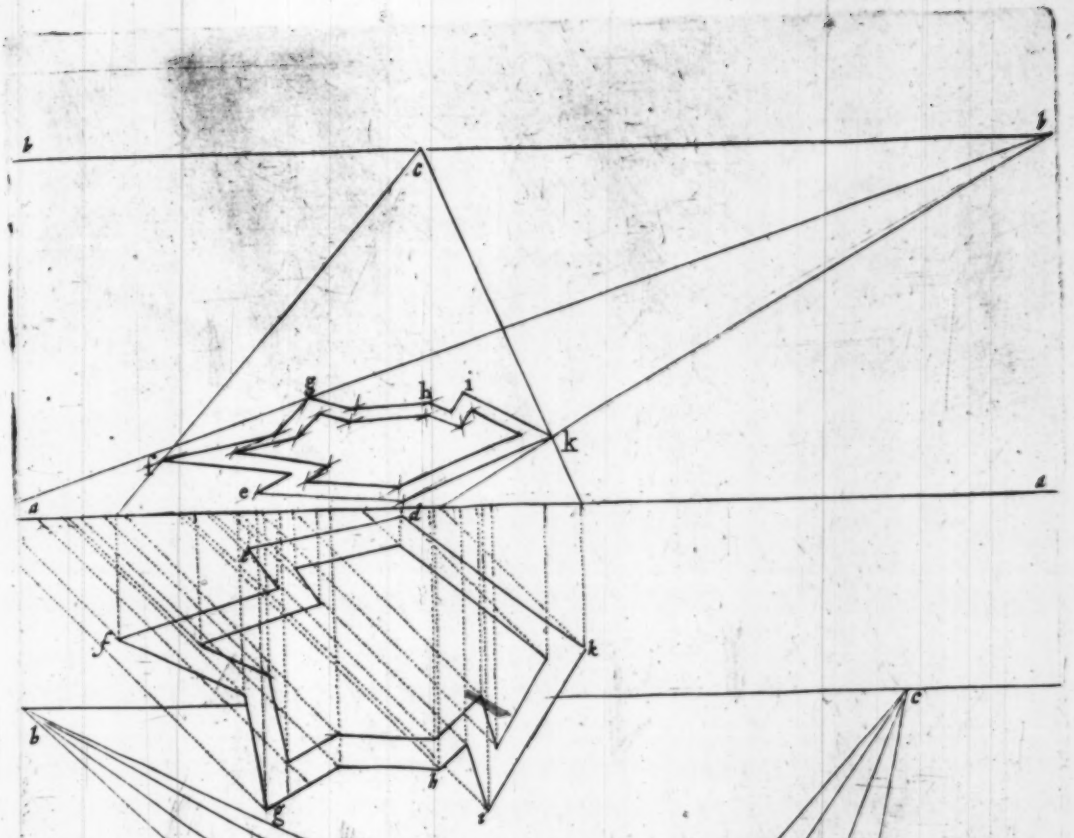


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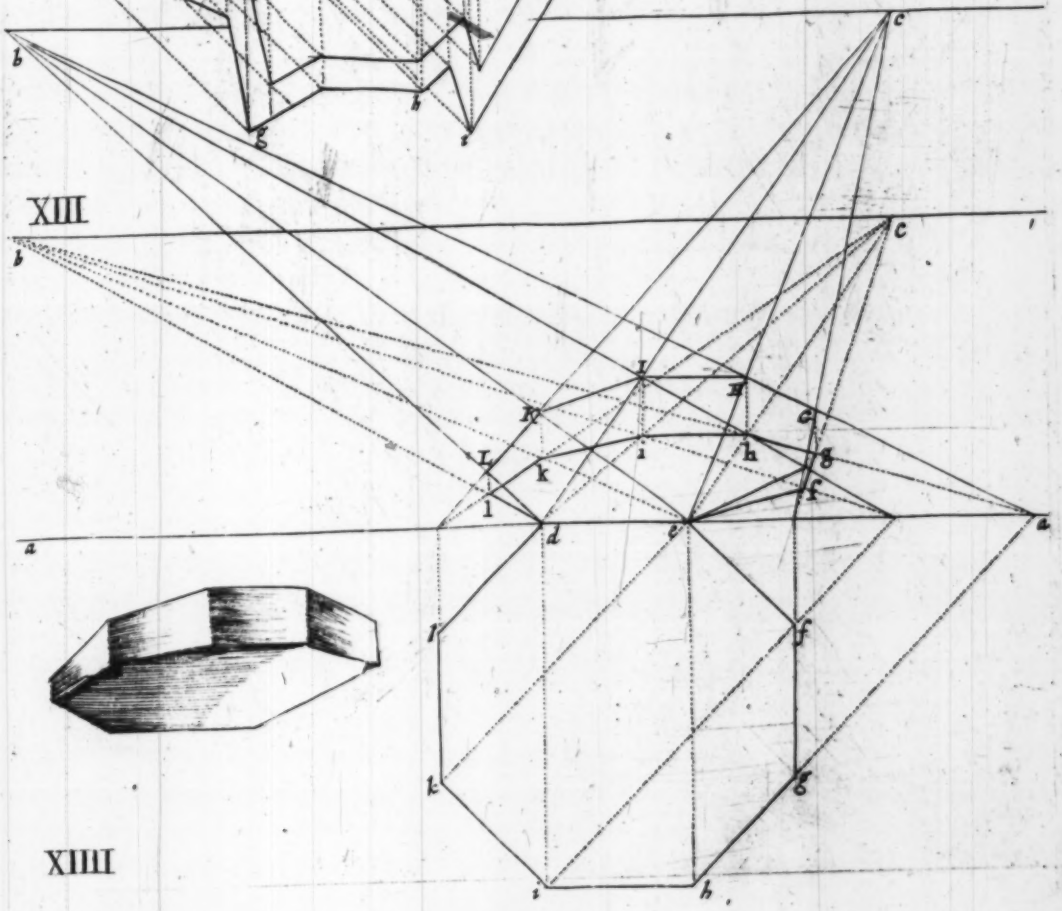







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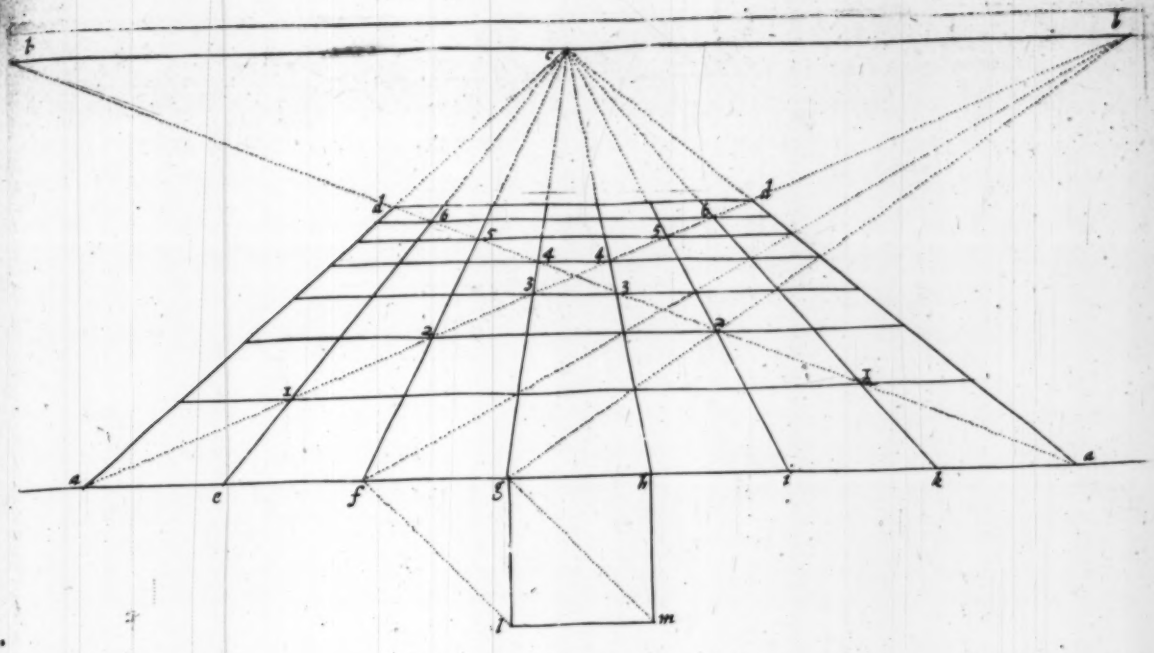


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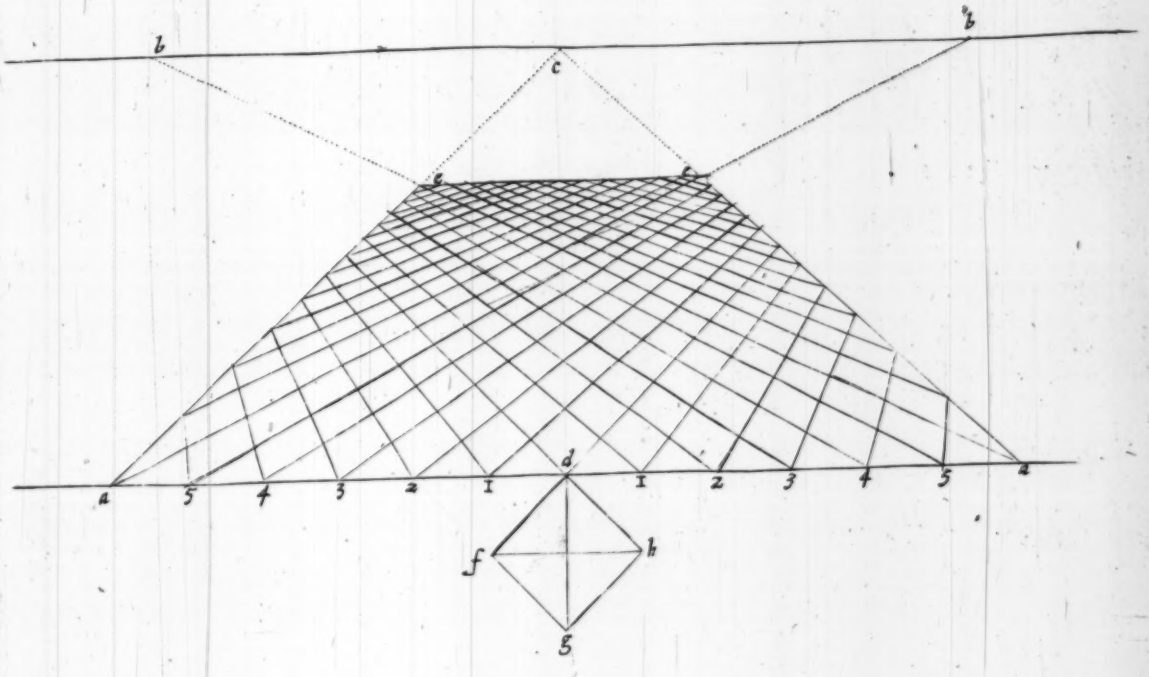


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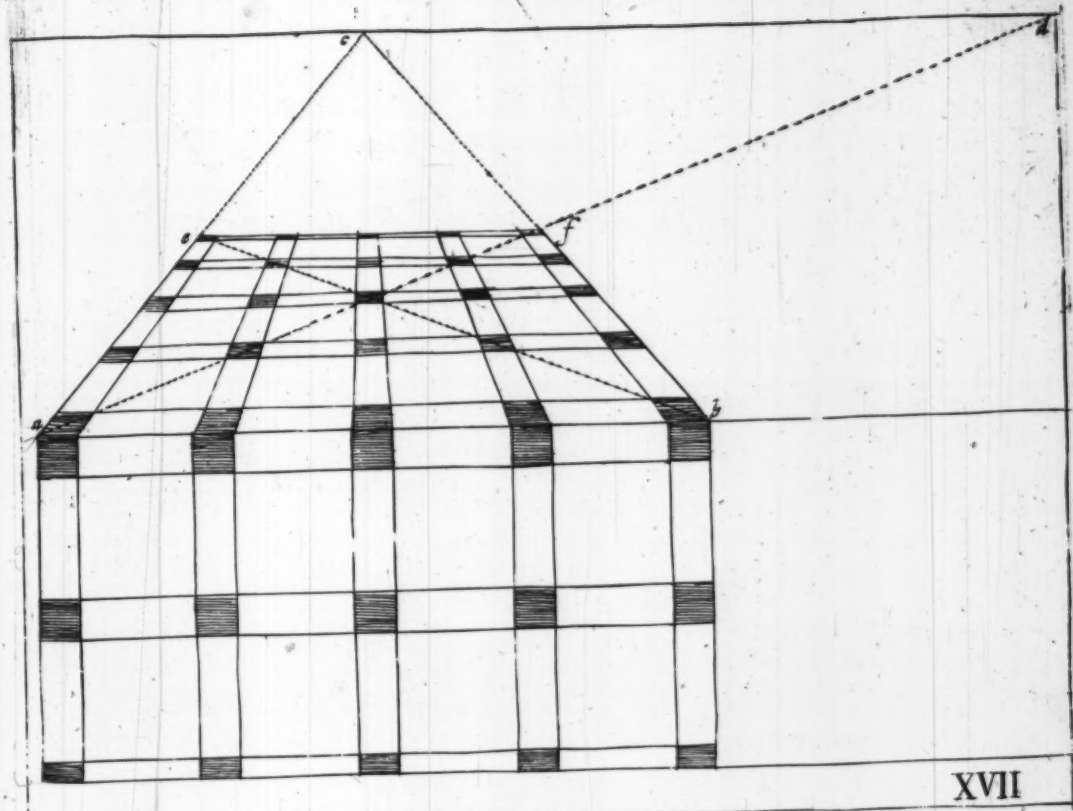


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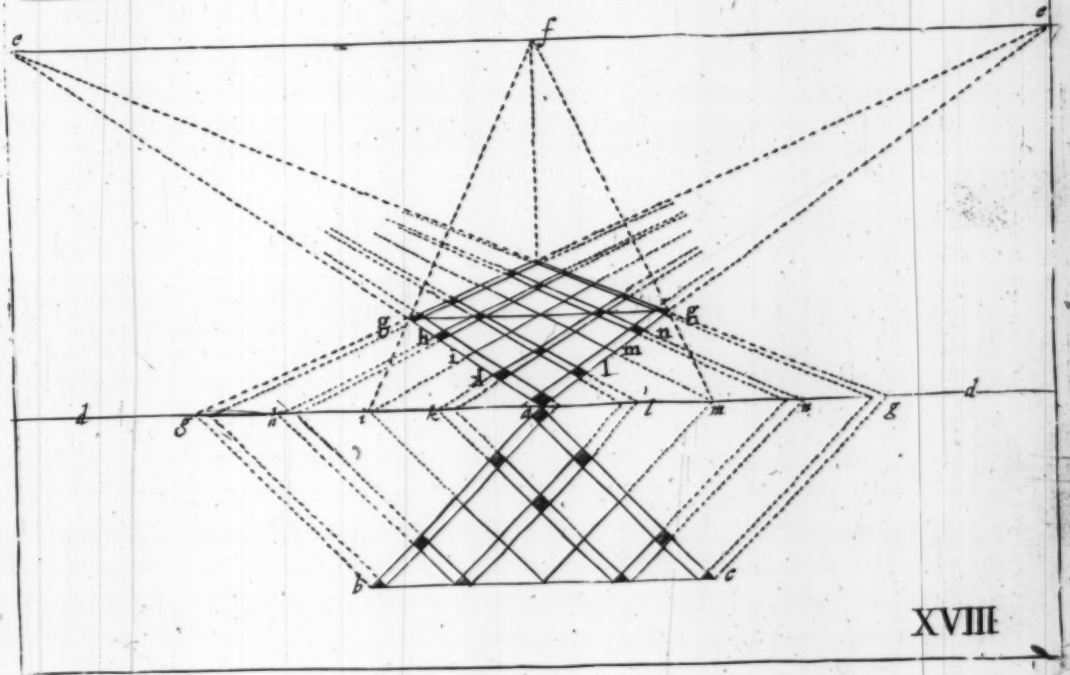


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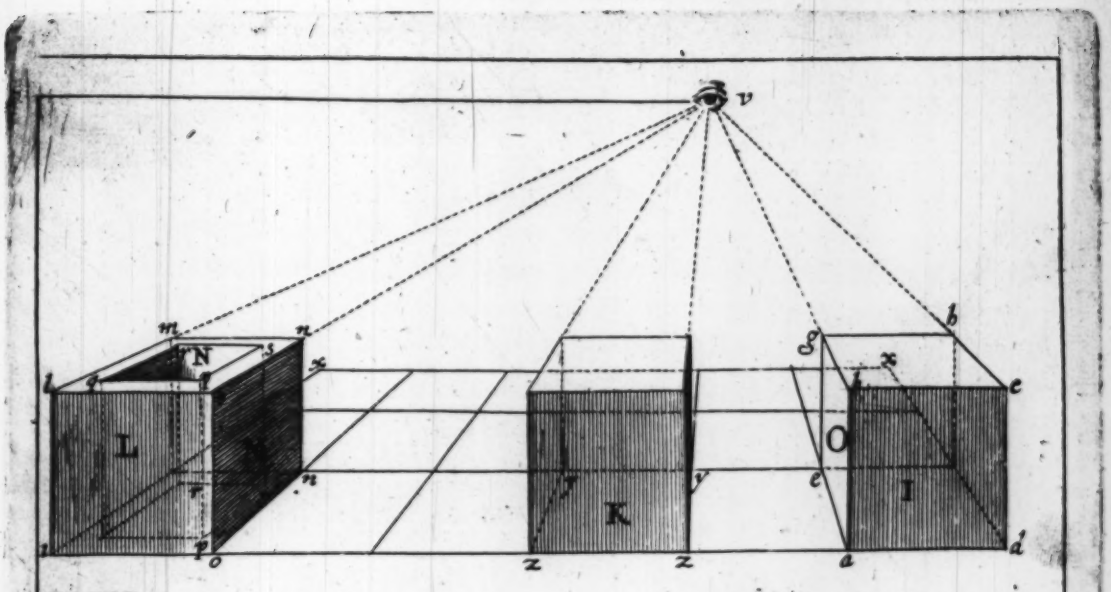


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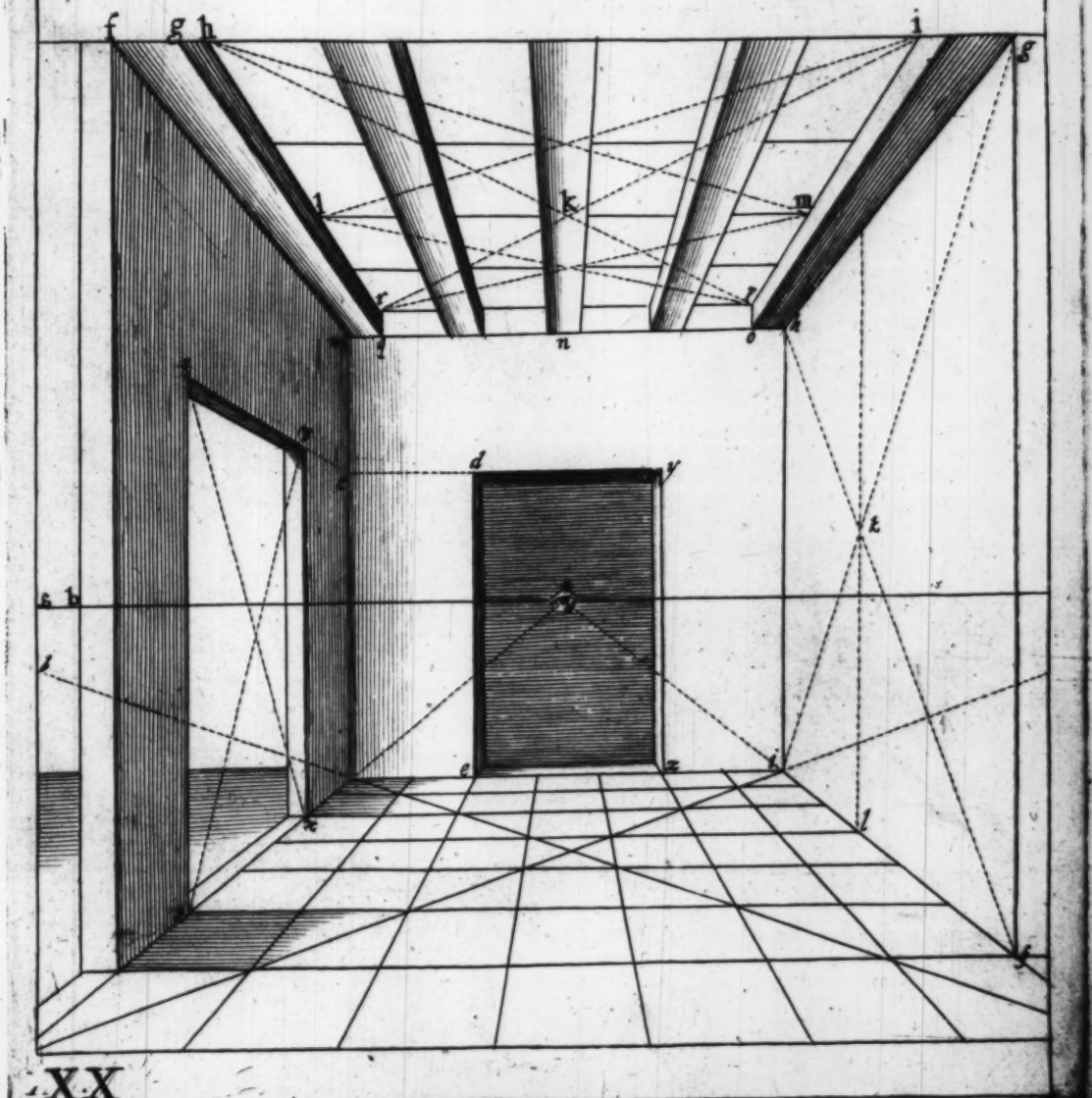


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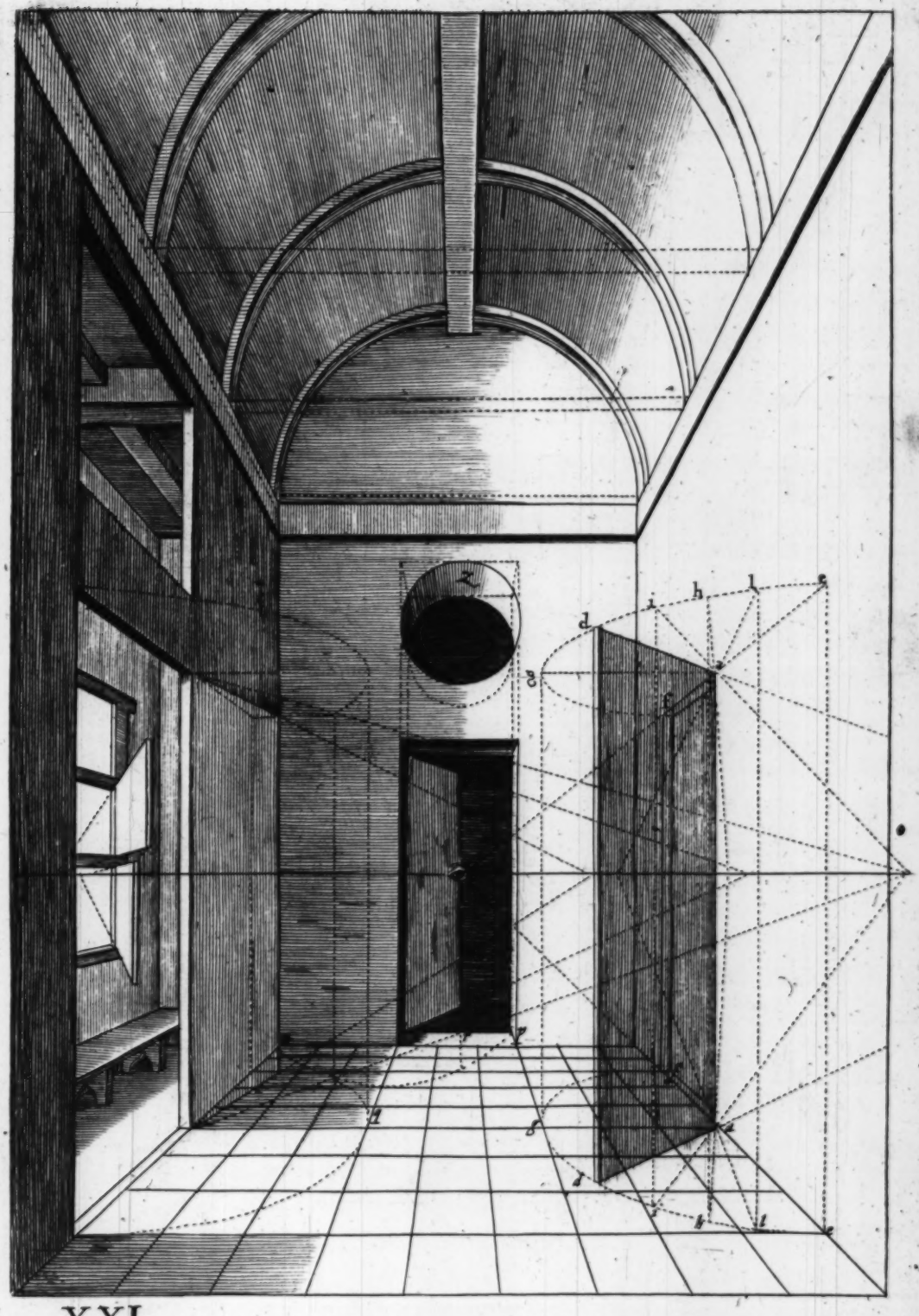


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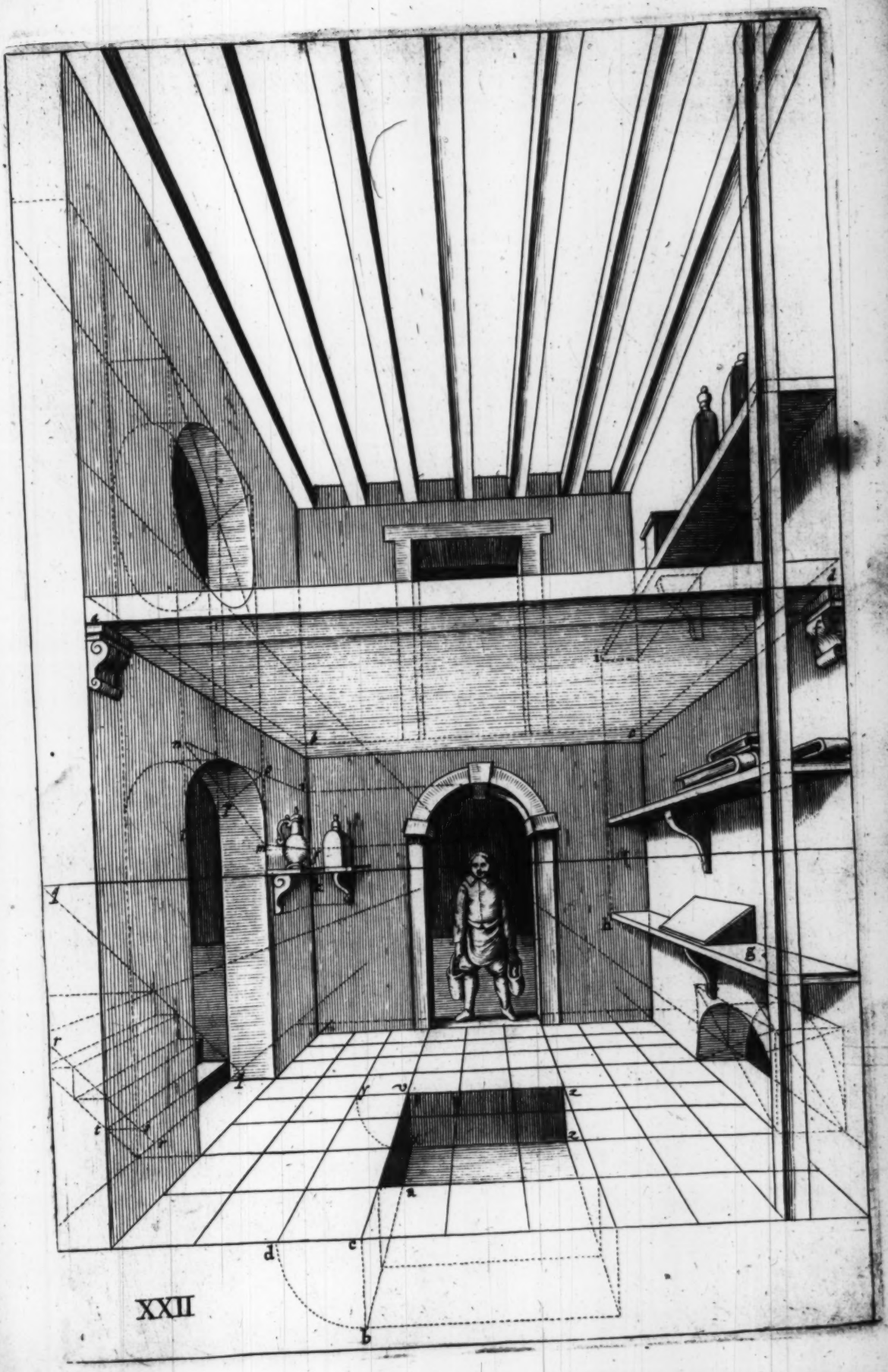
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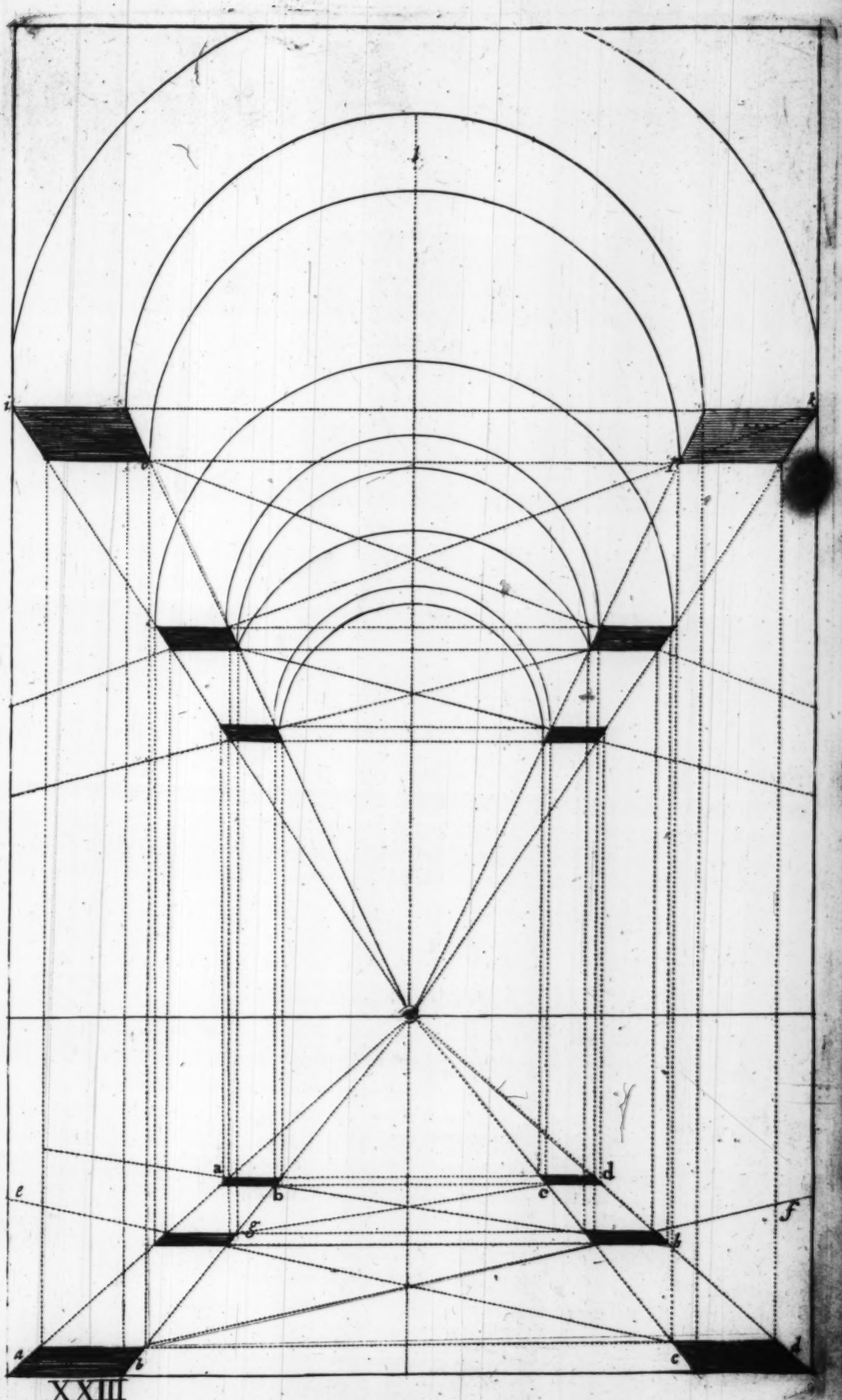


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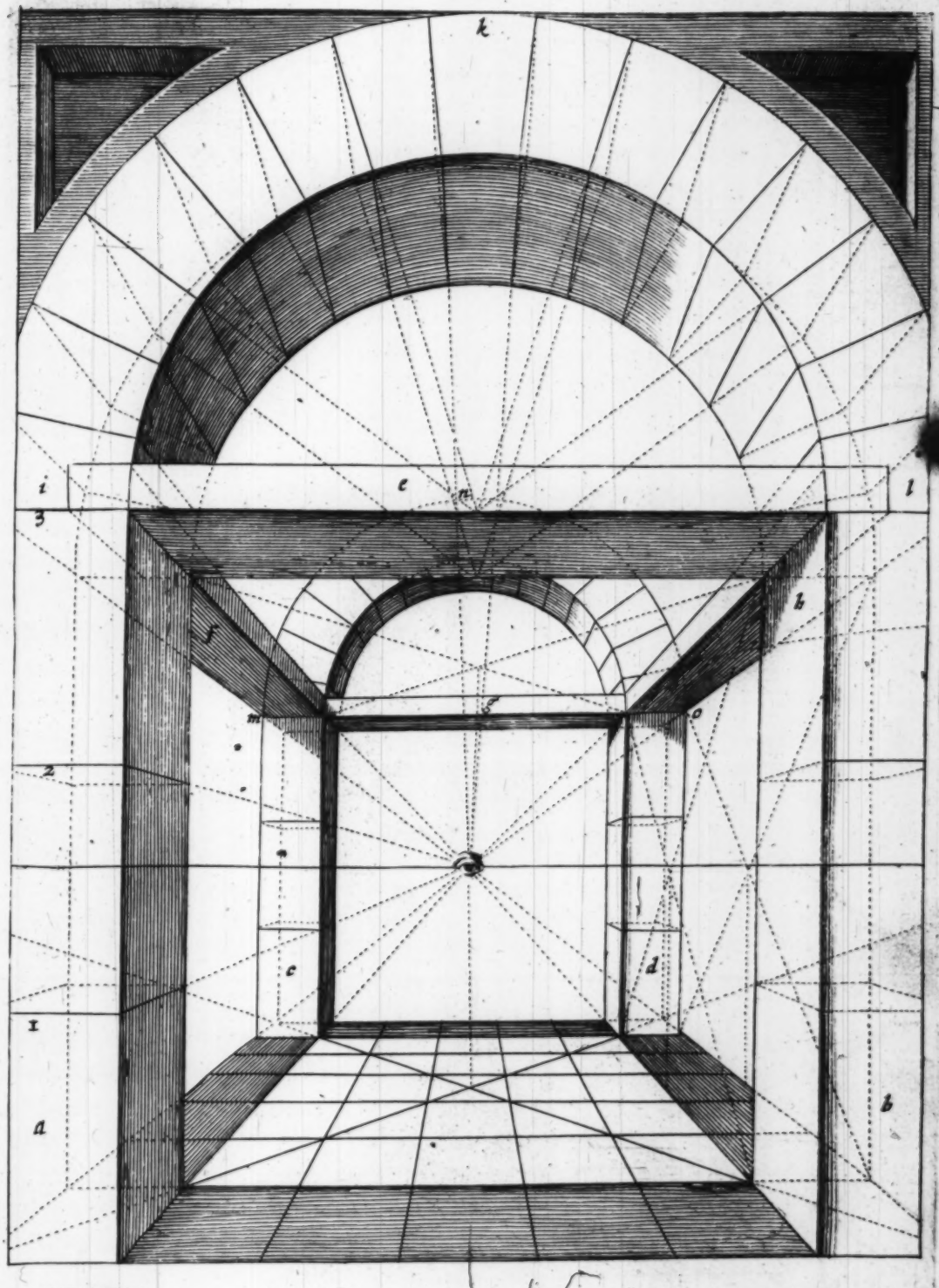


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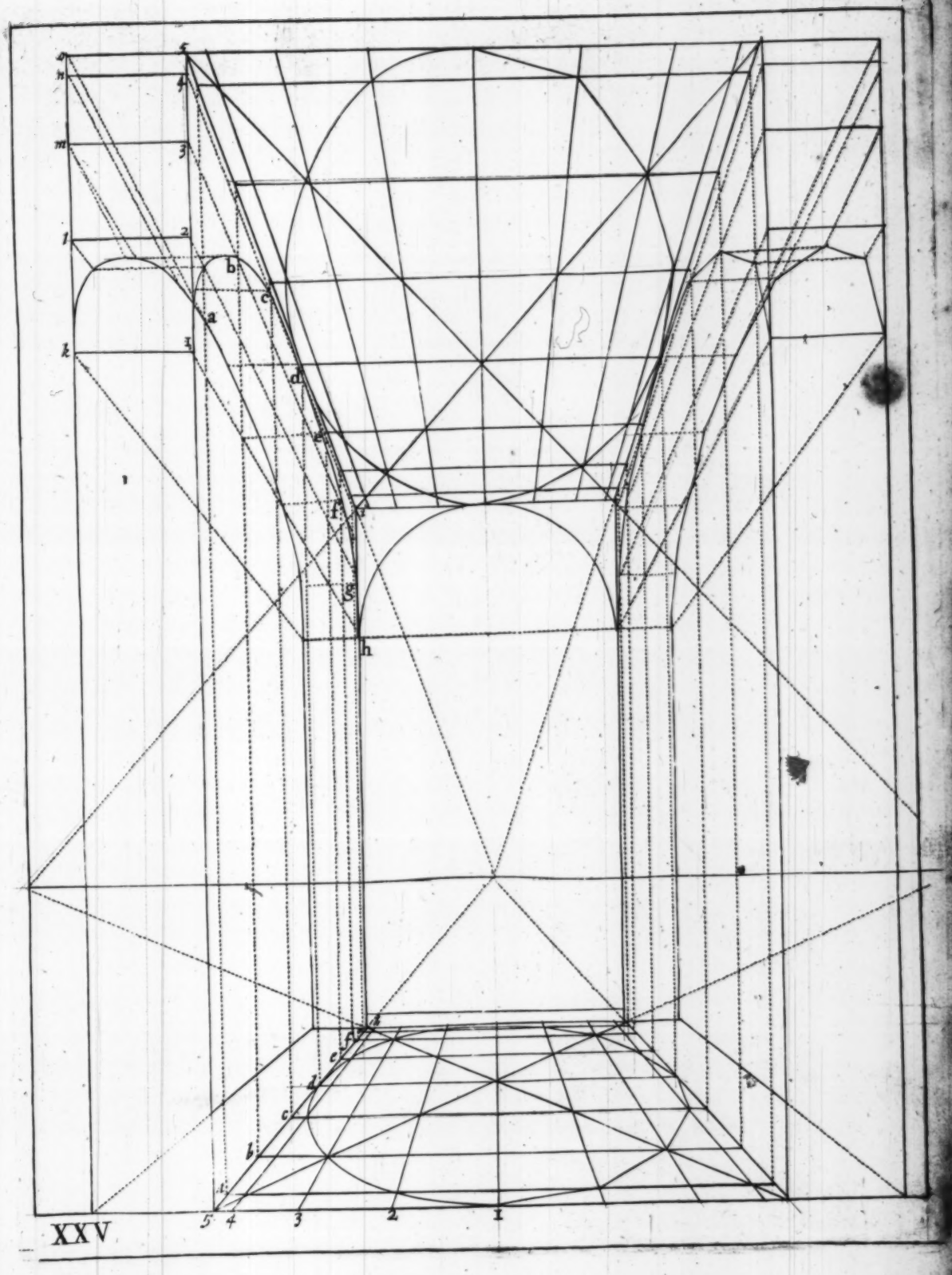
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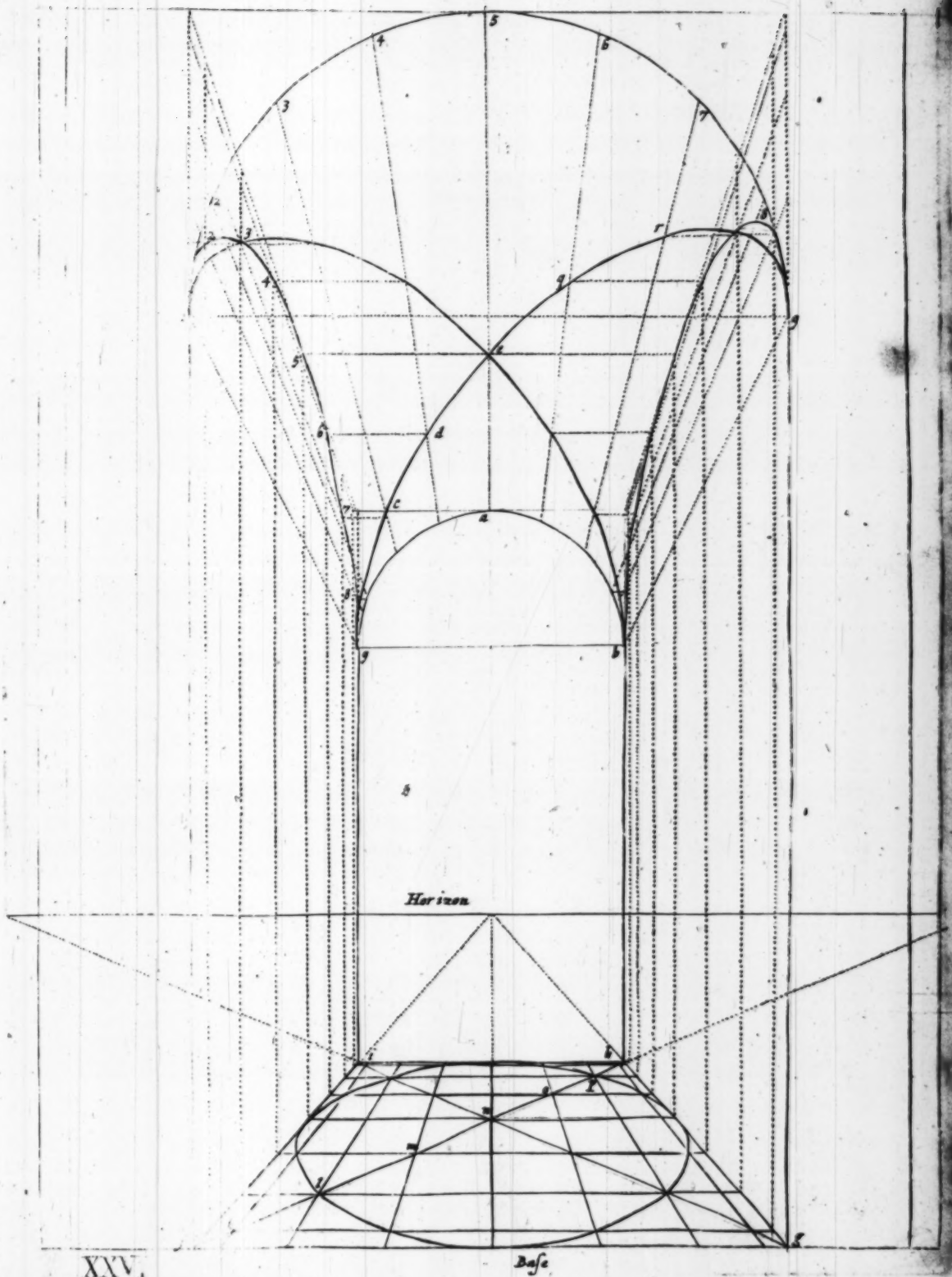


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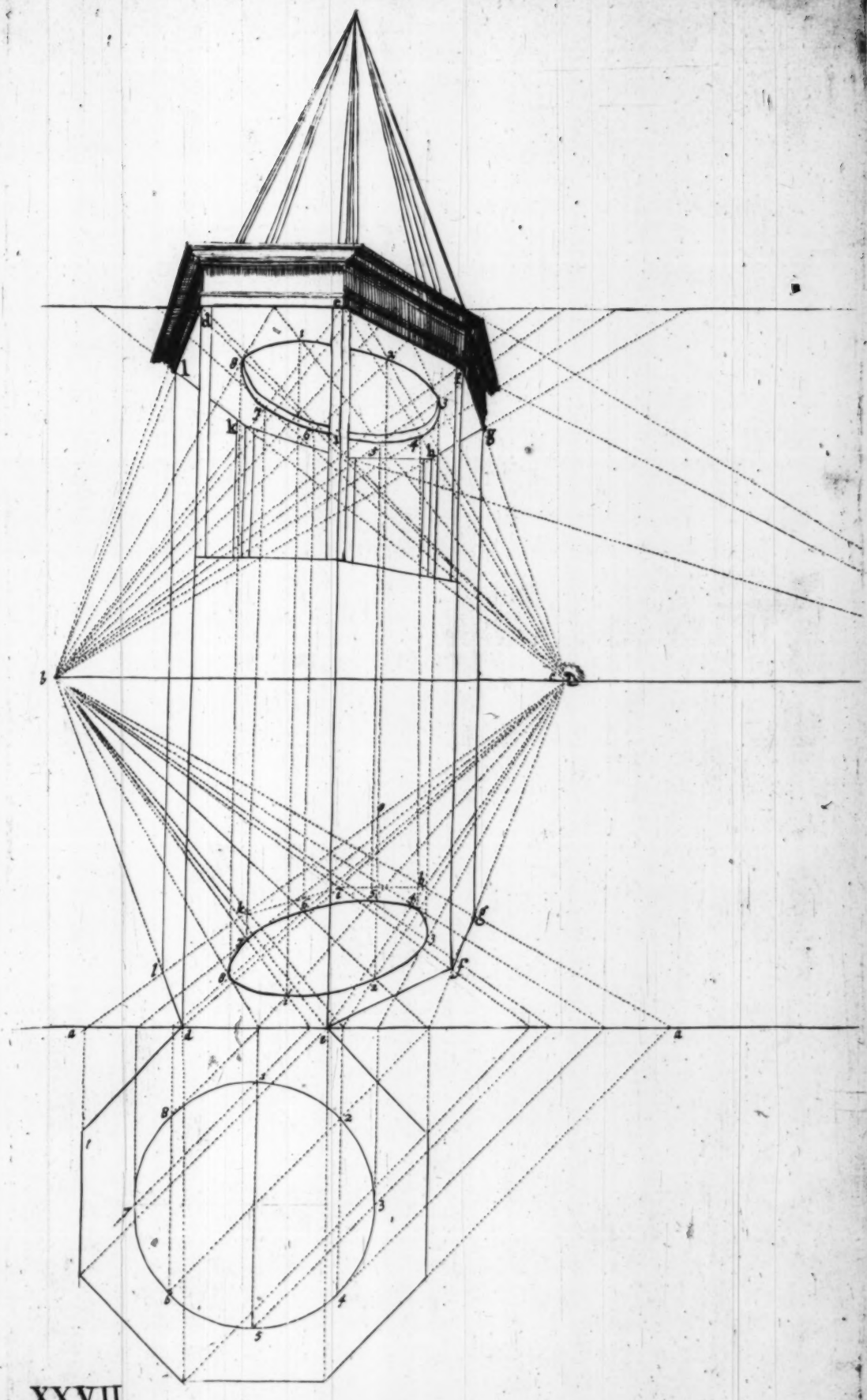

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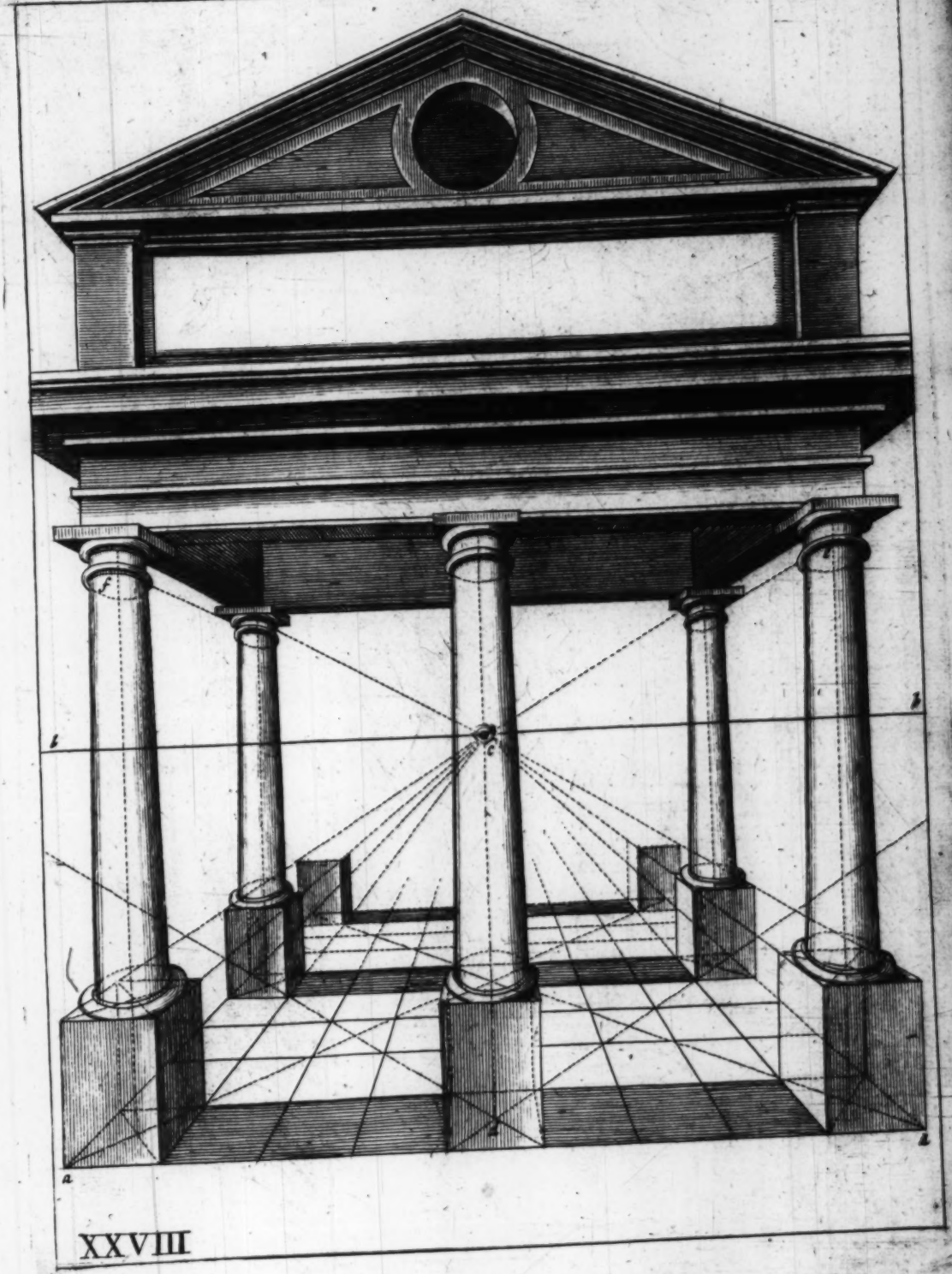


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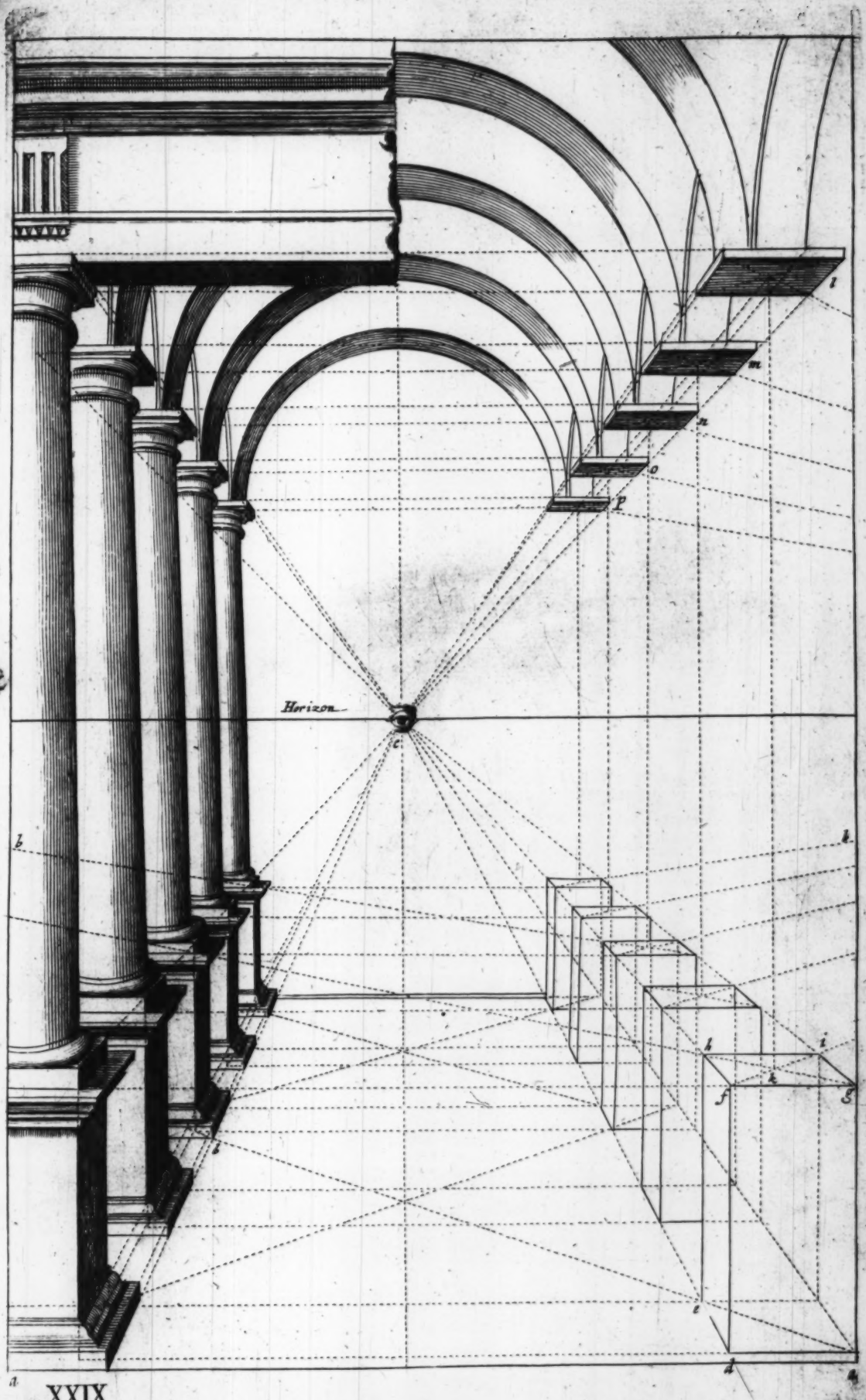


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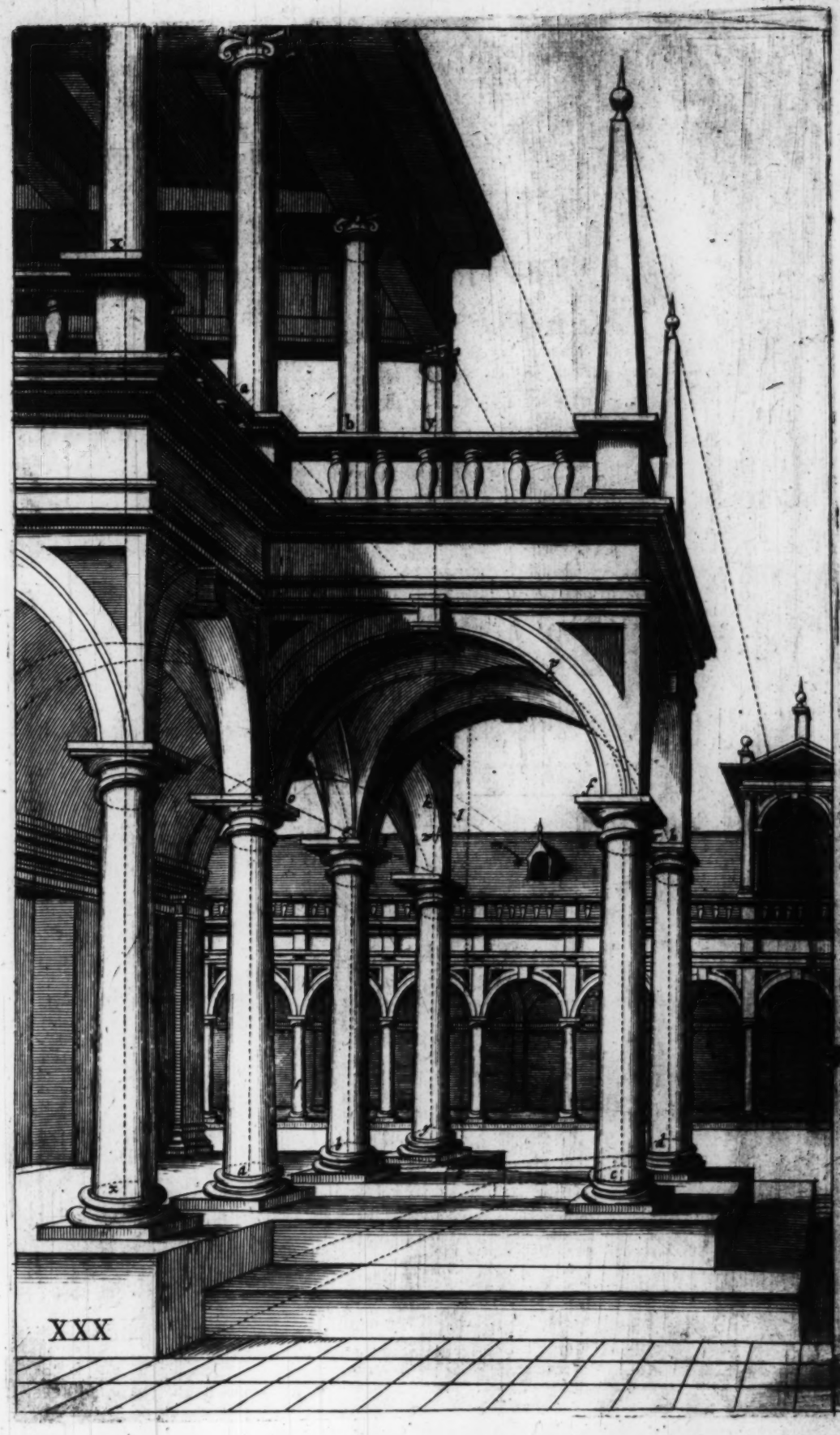

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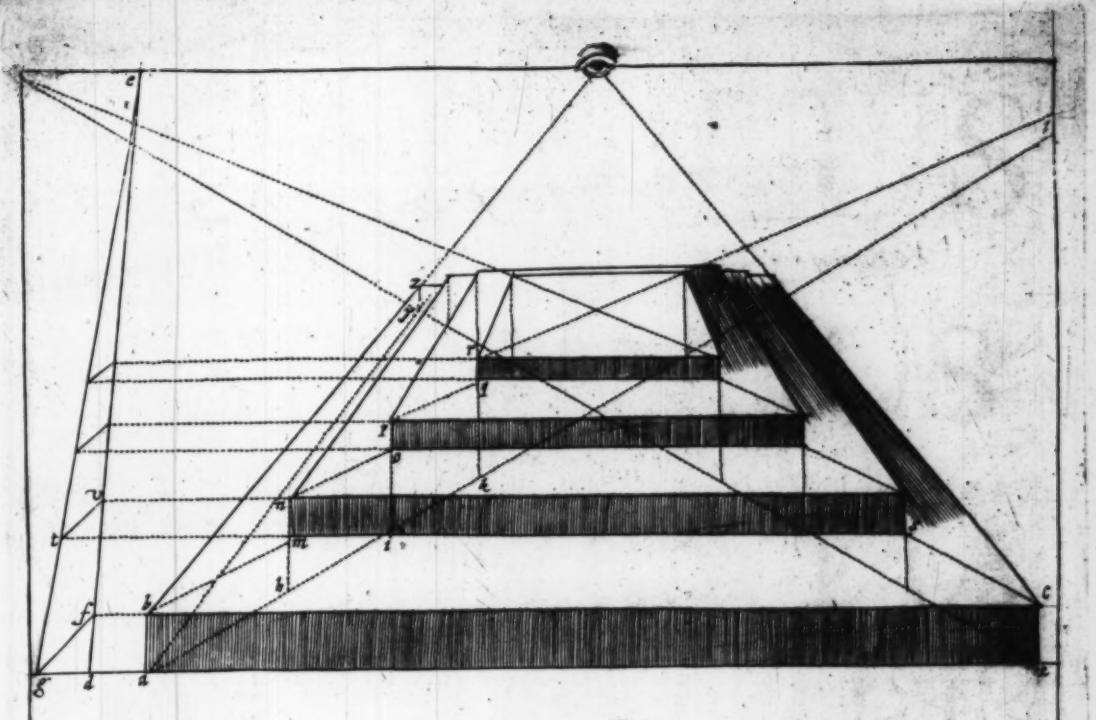


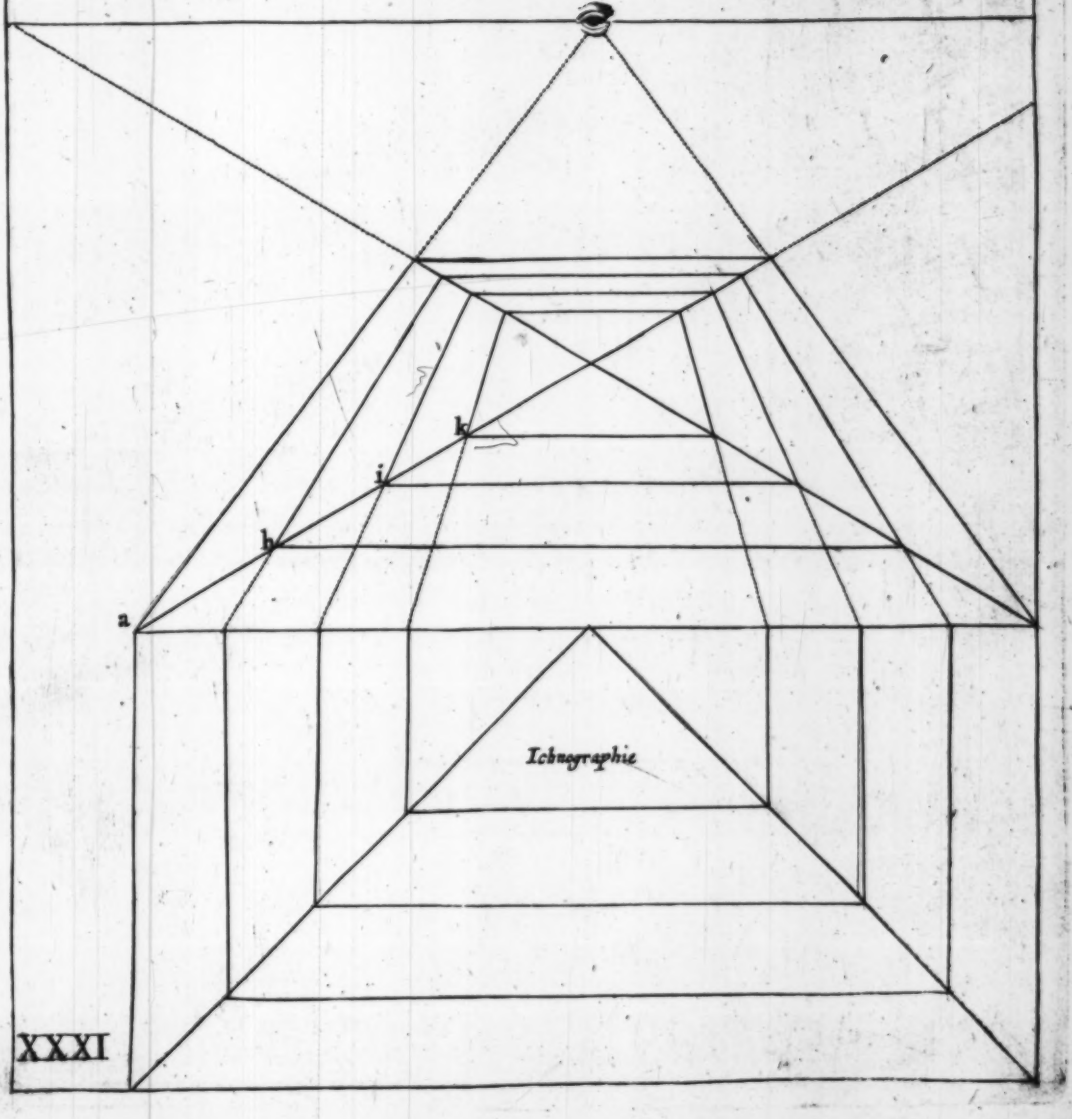


XXXI

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# CAROLUS SECUNDUS DEI GRATIA MAGNA BRITTANIA FRANCIA ET HIBERNIA REX &c.

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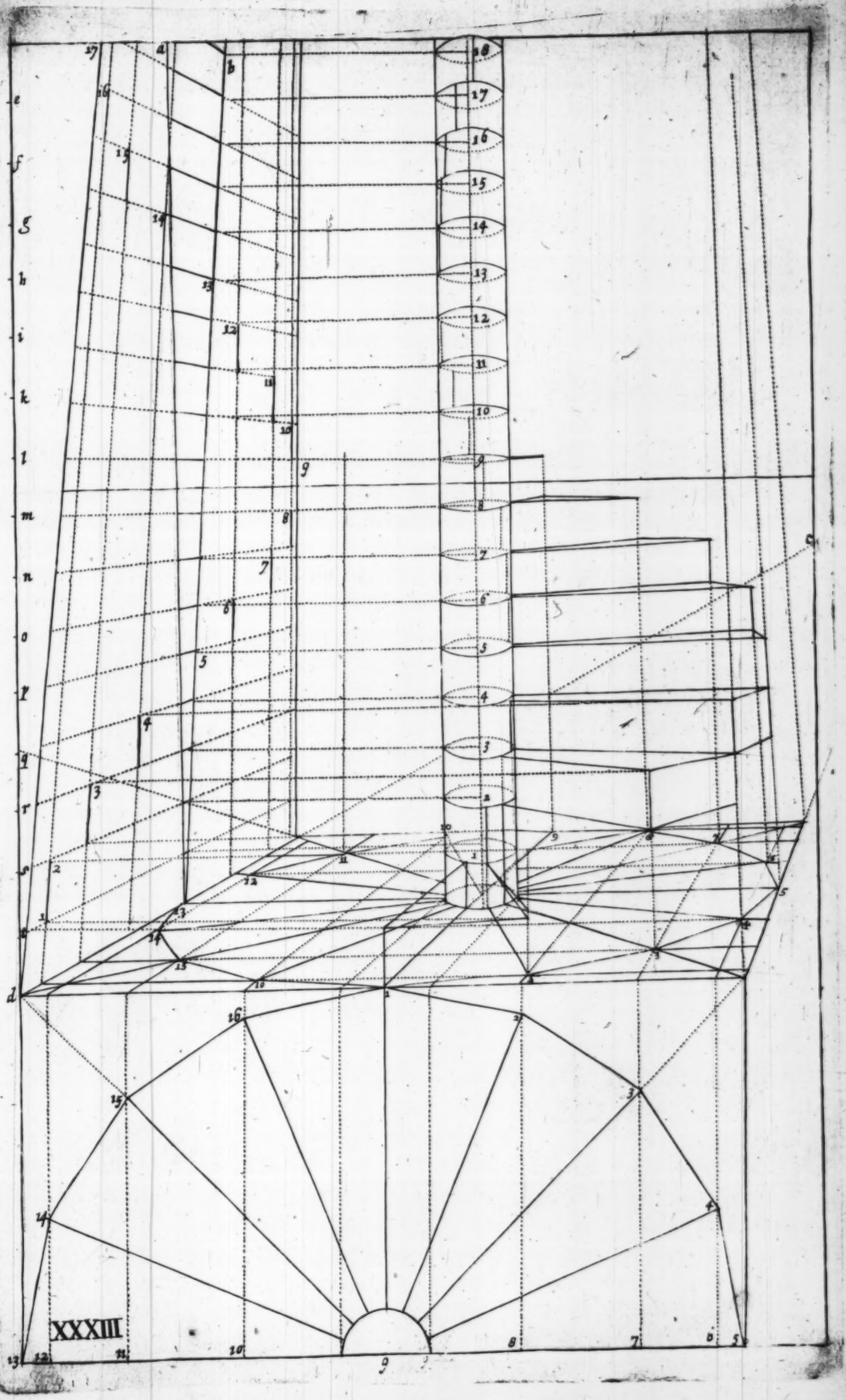
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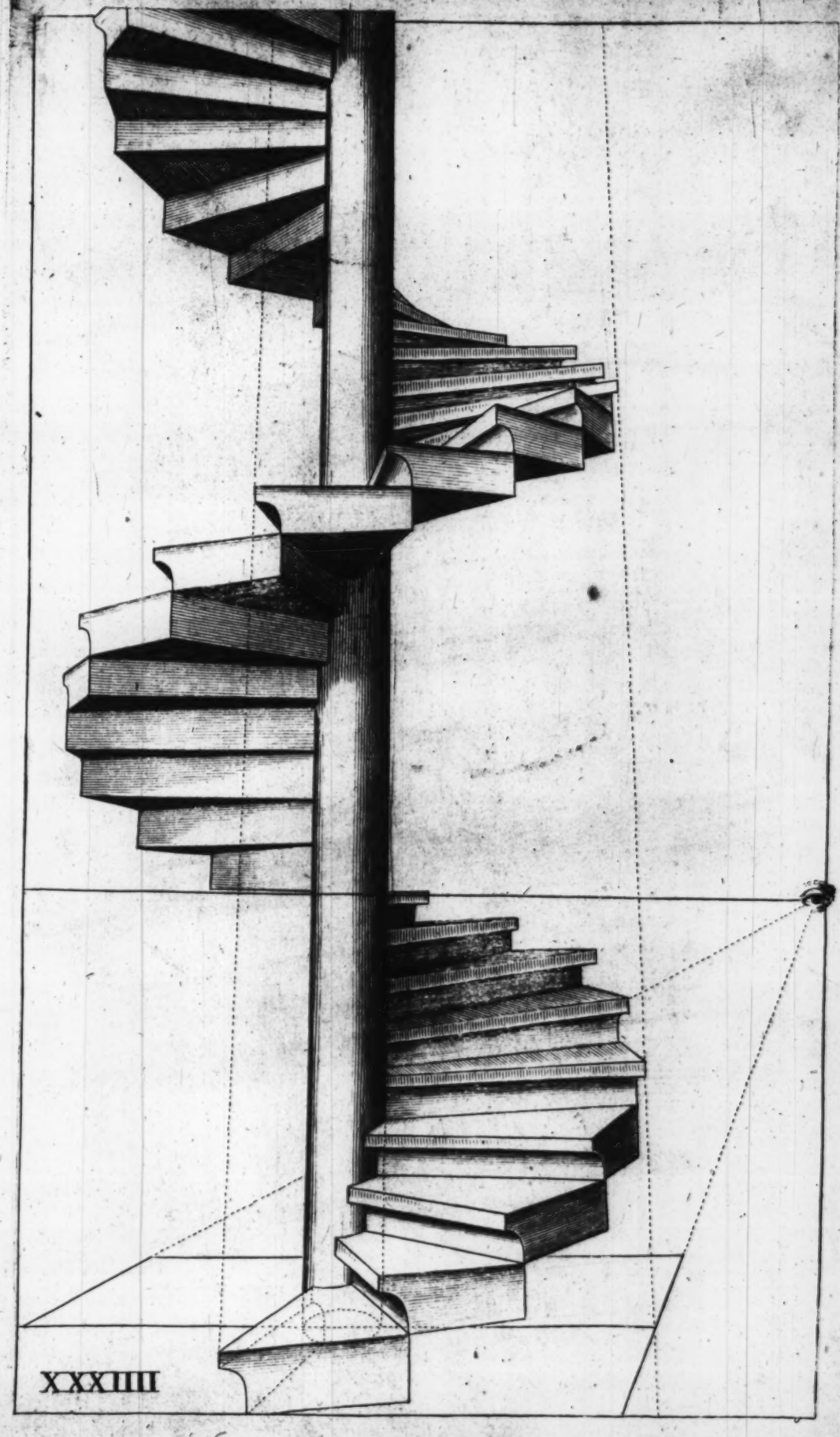

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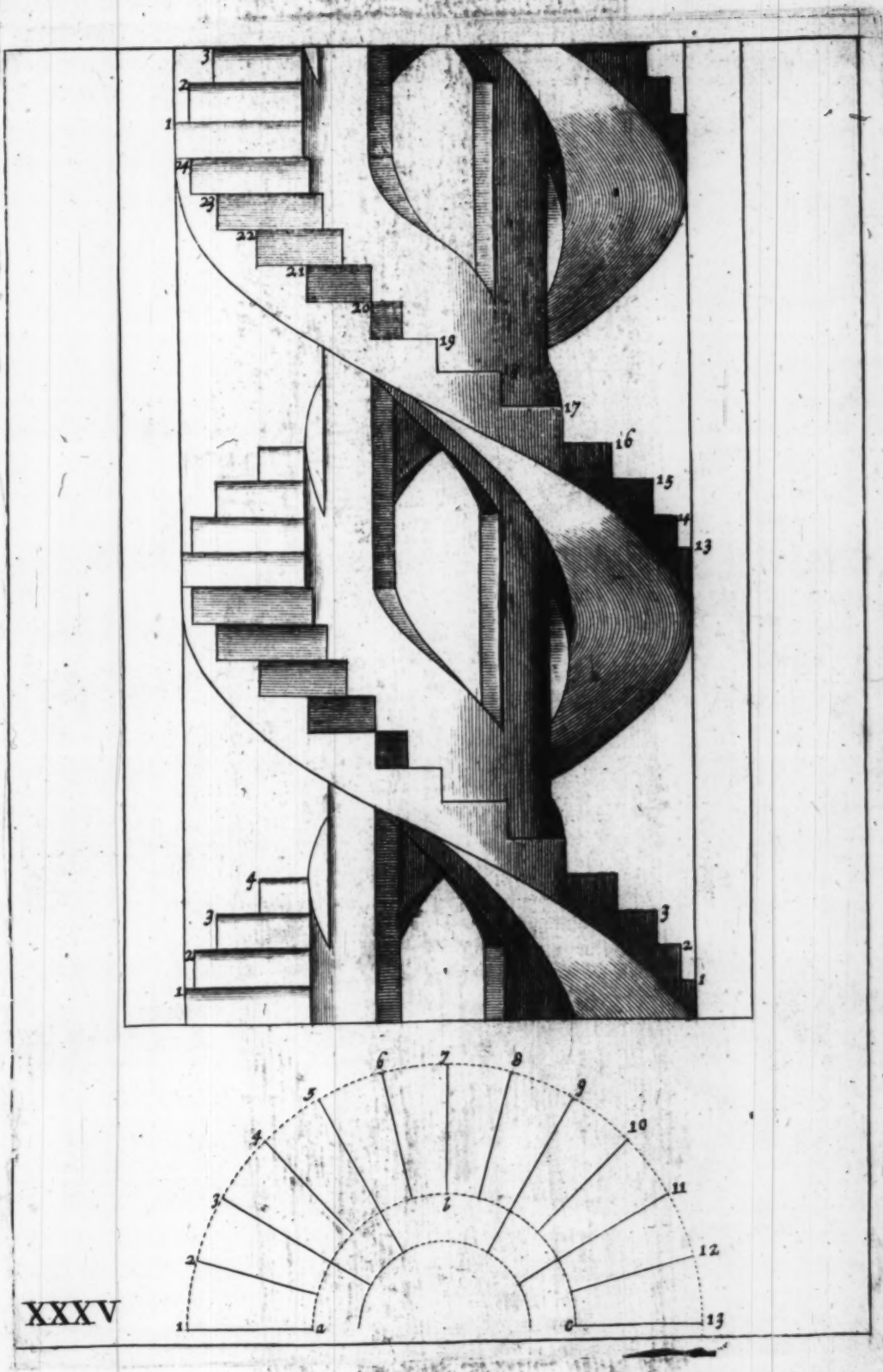
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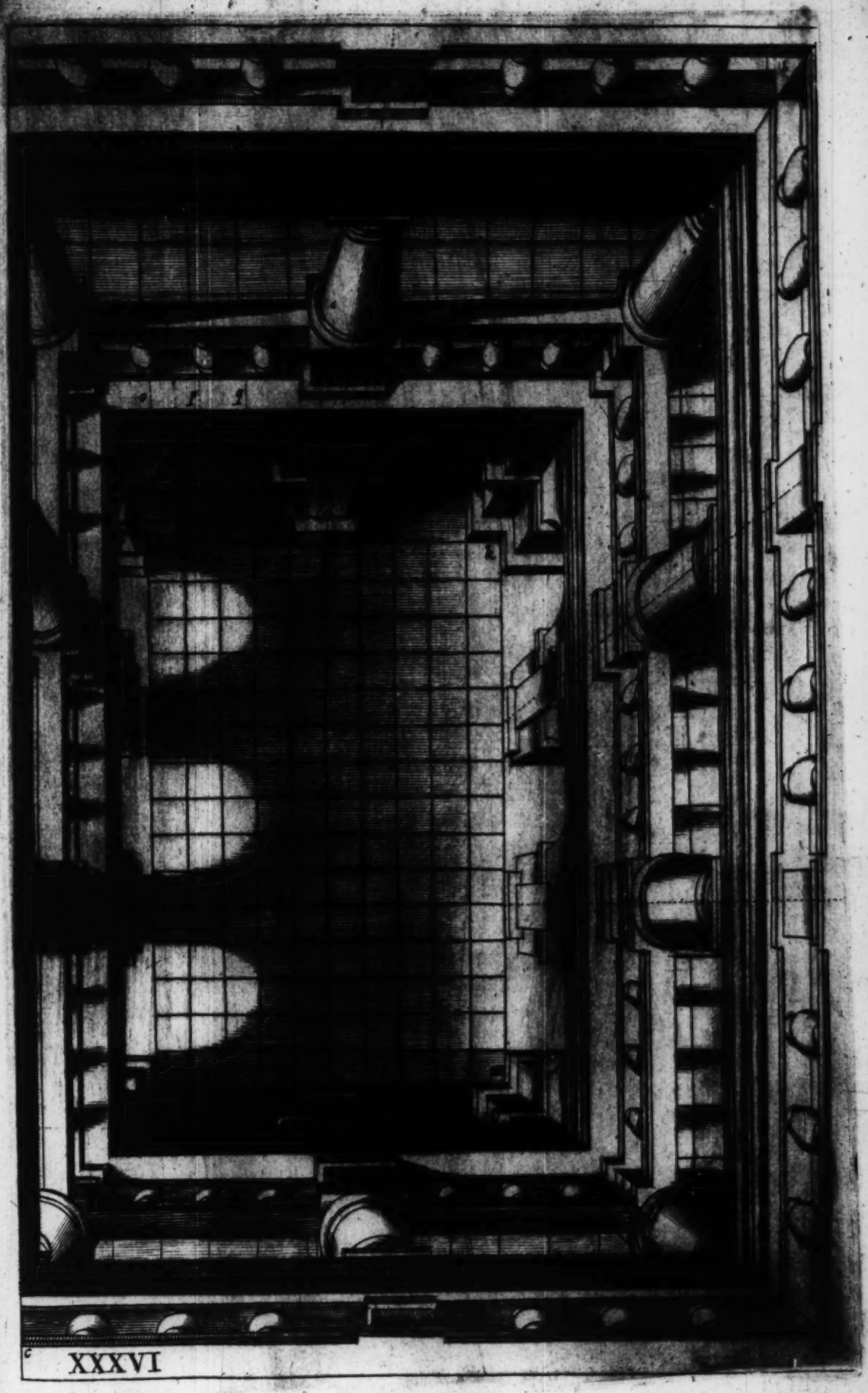

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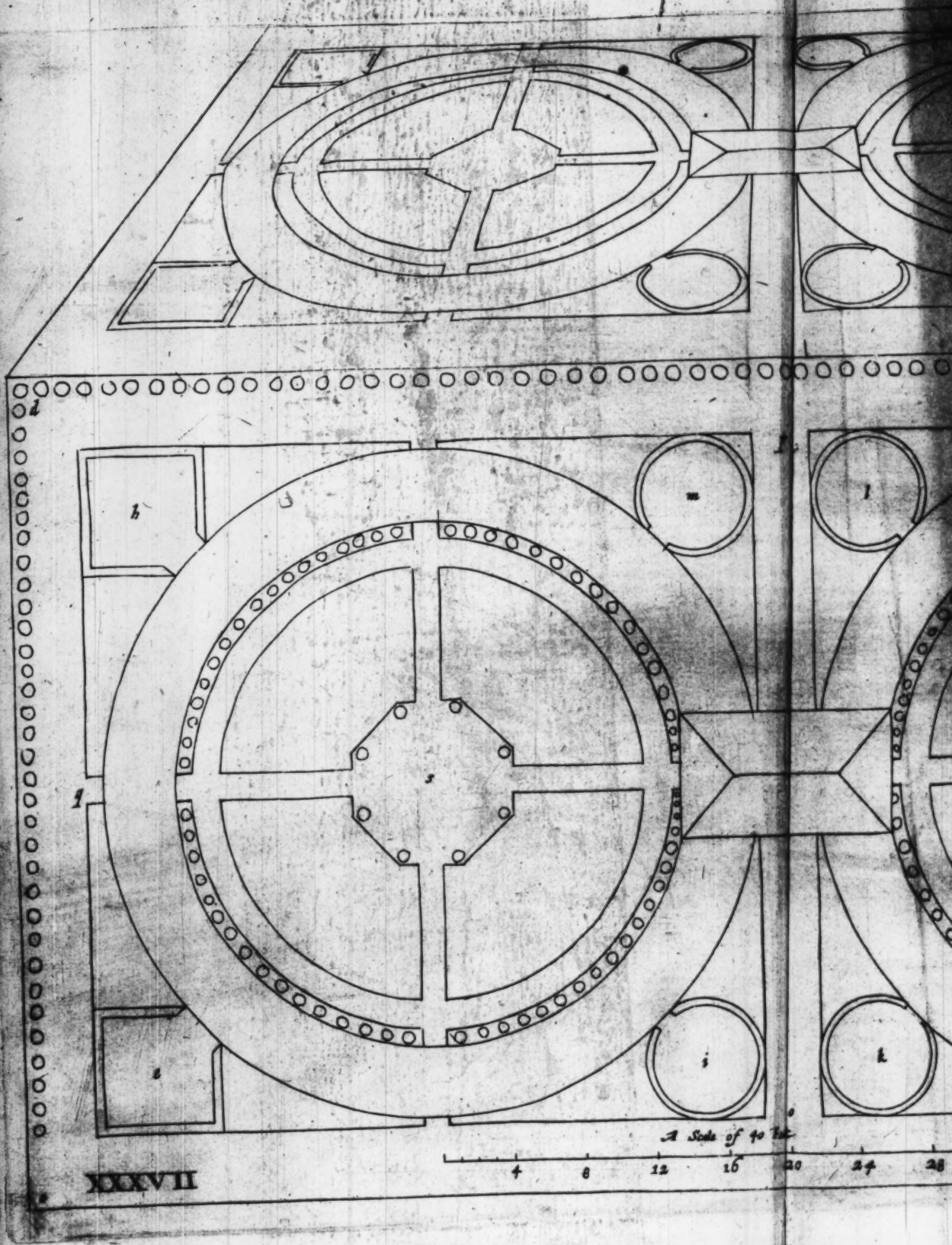


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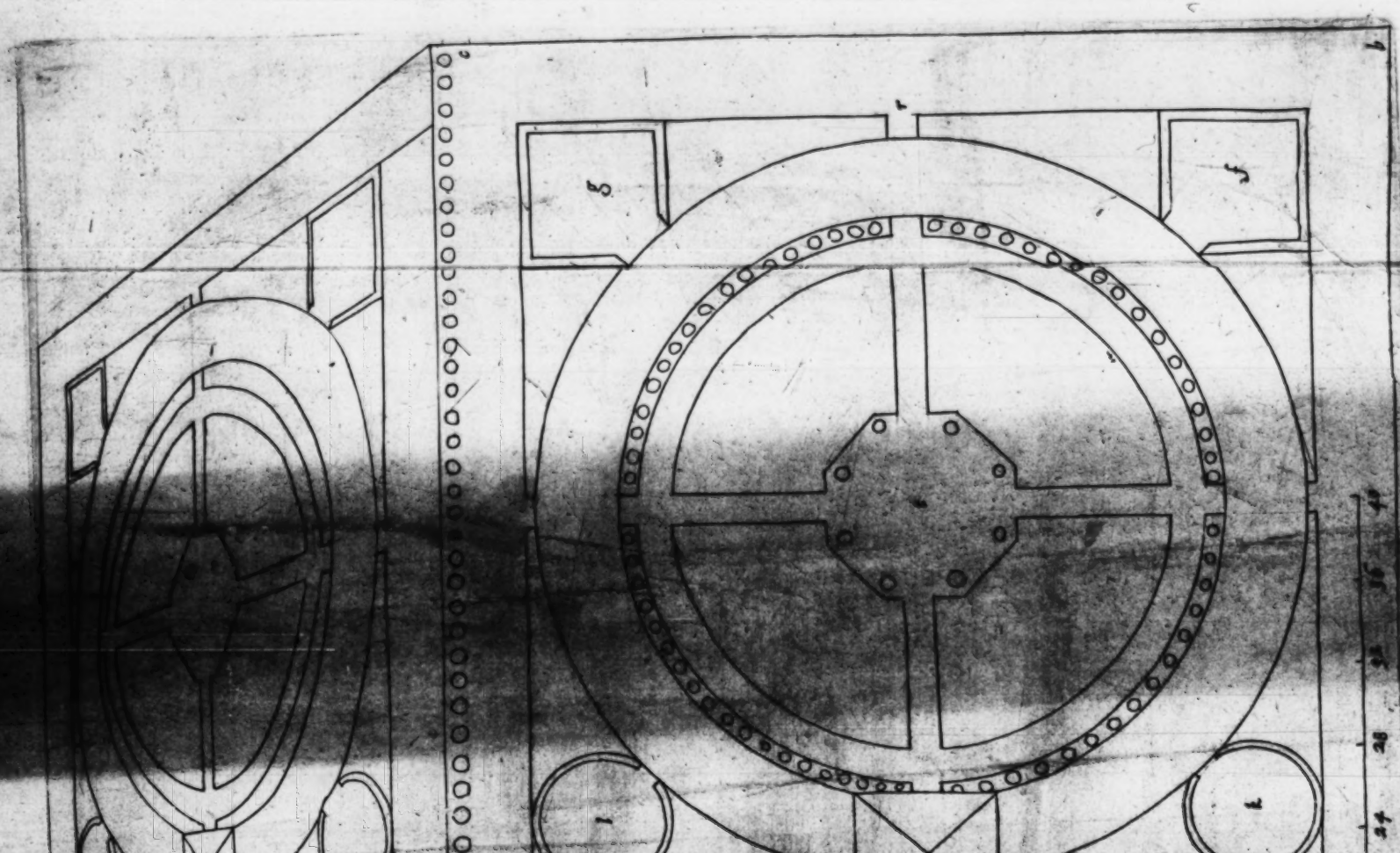

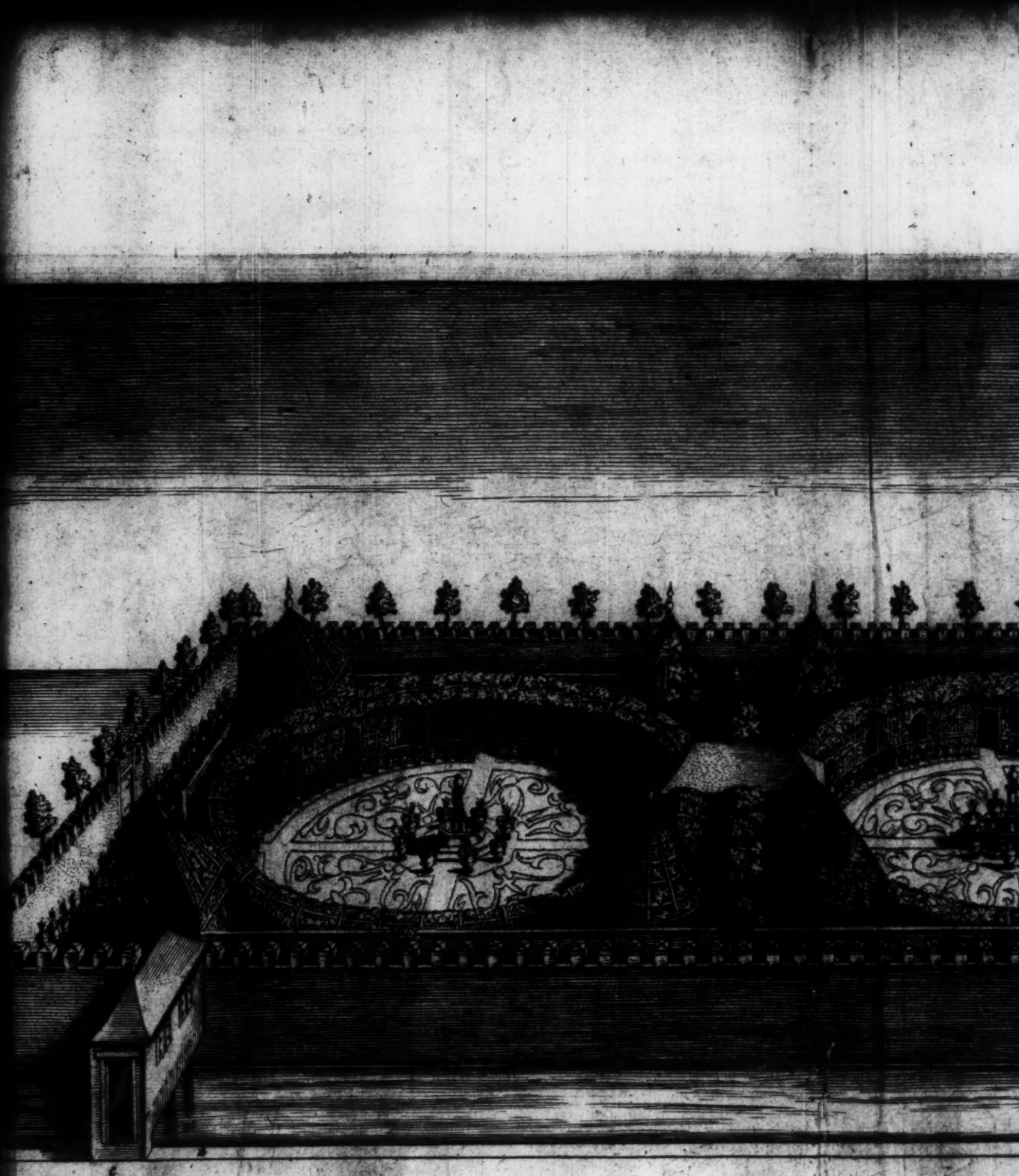

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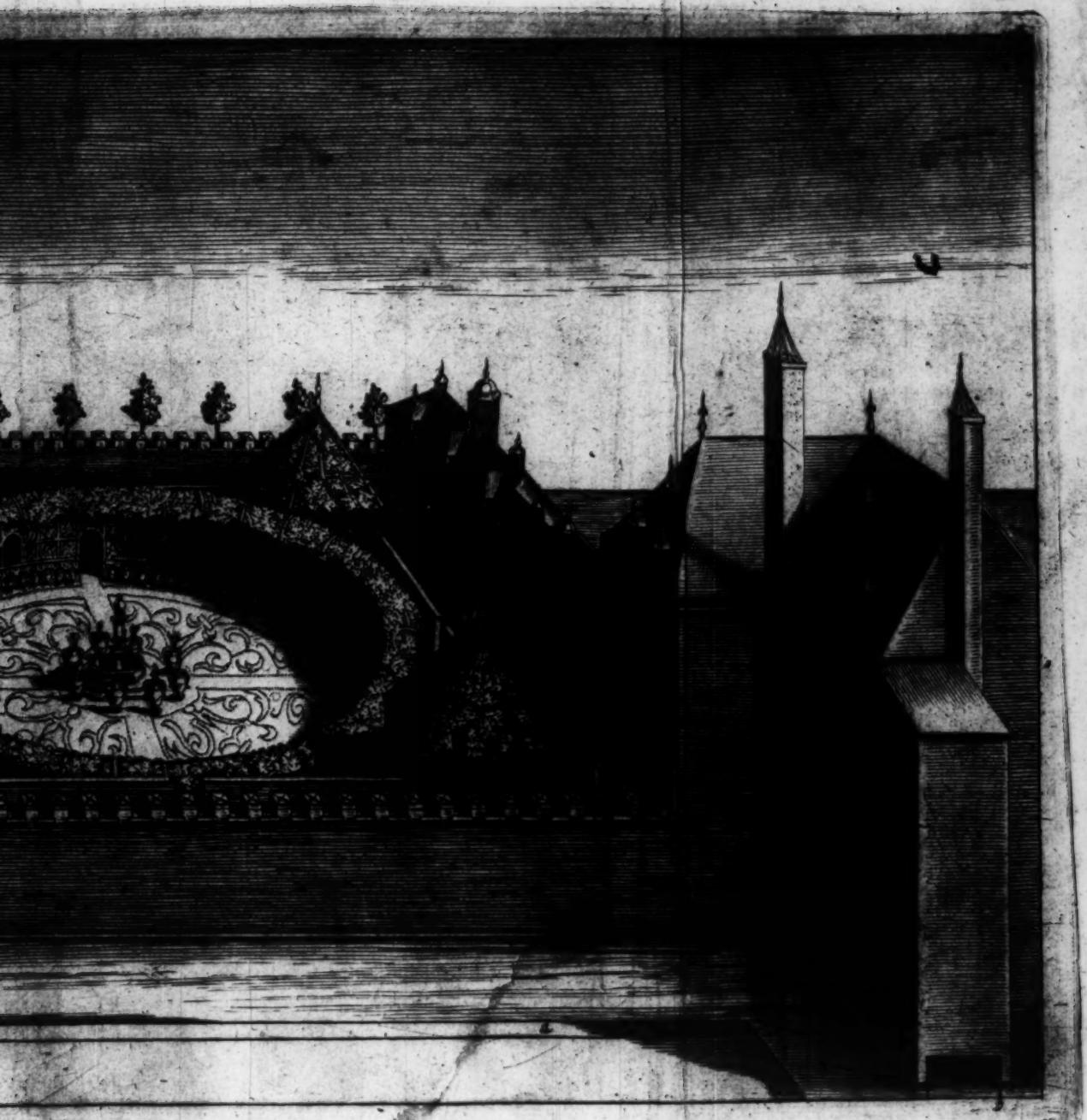

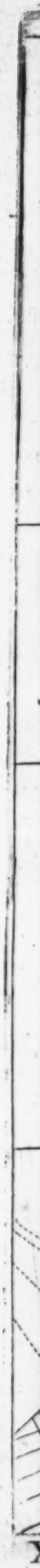

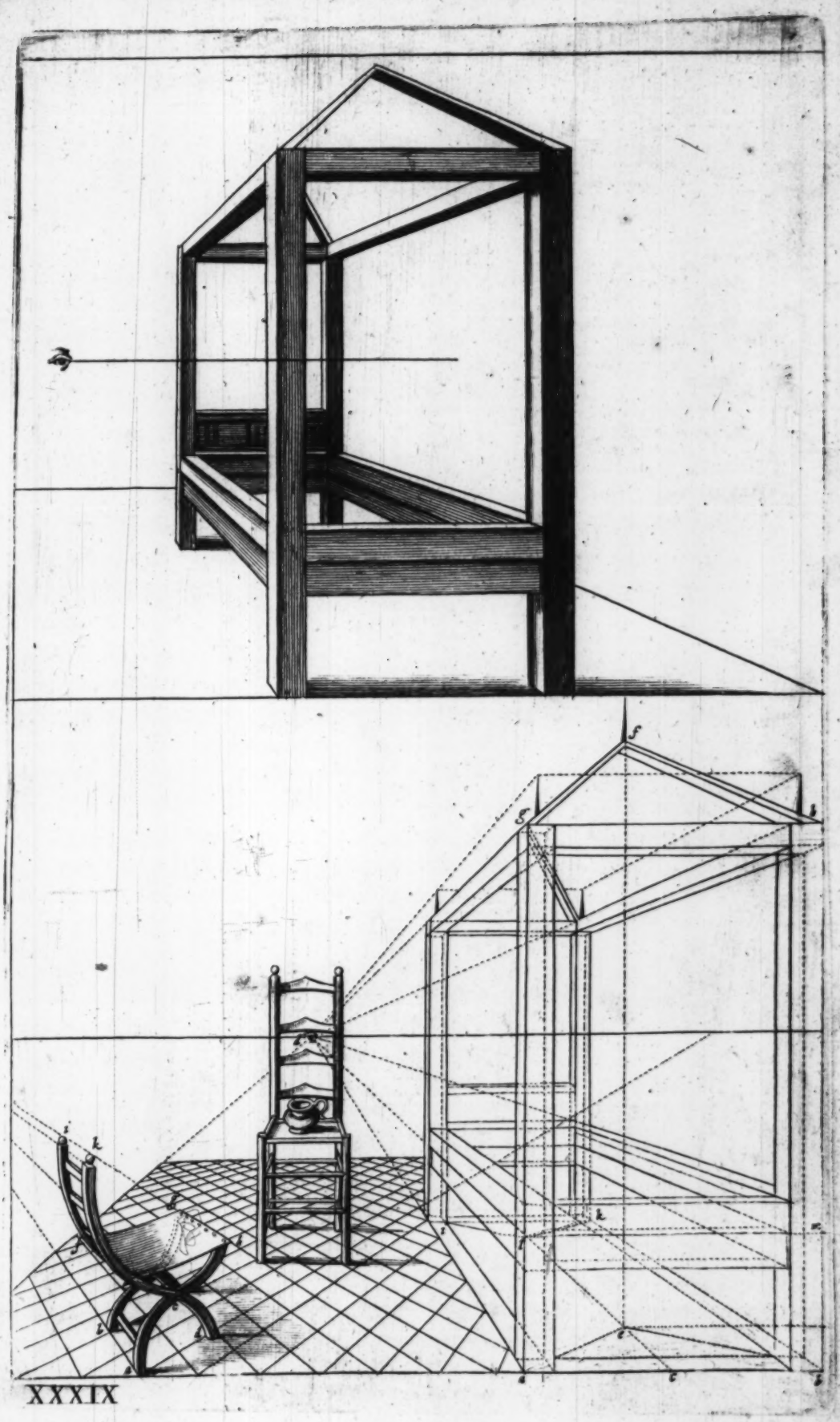

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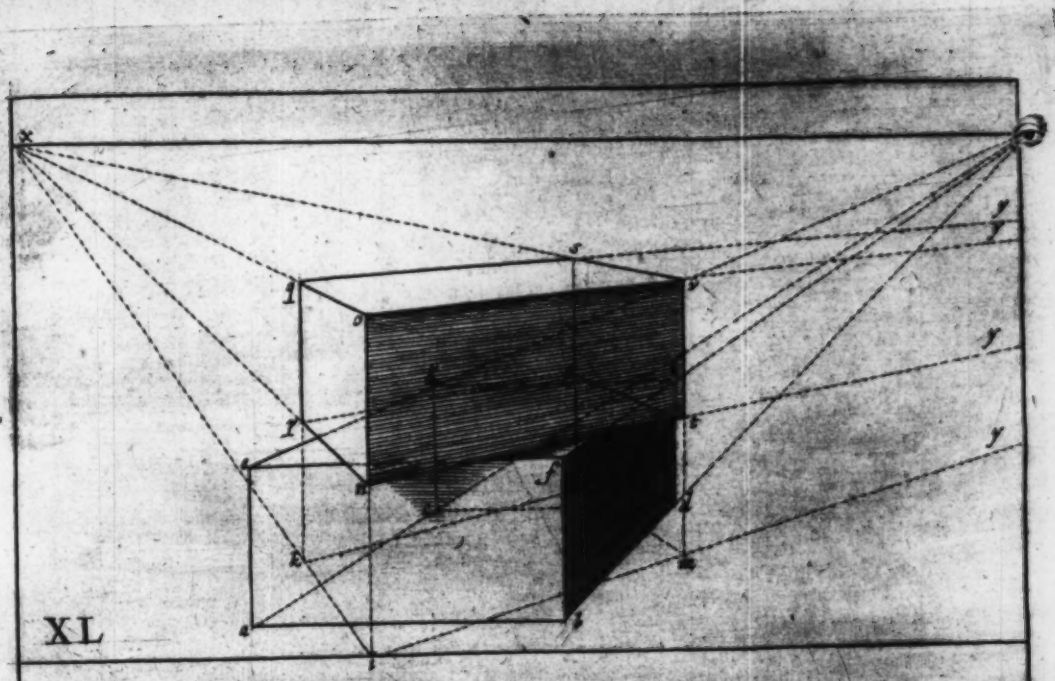

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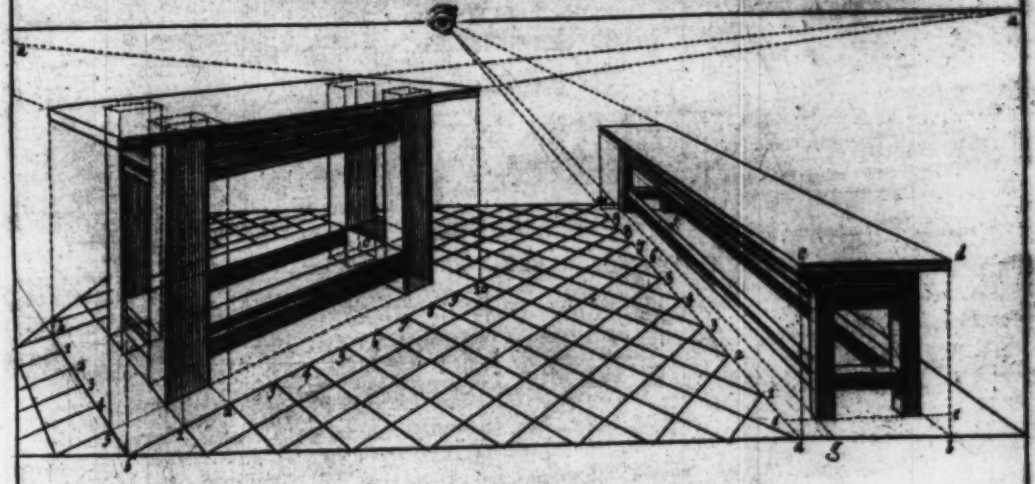

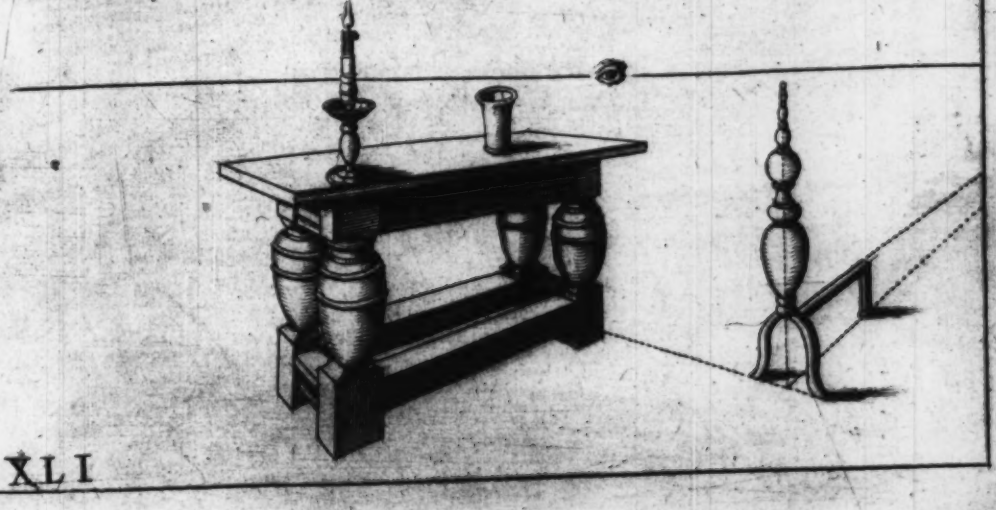

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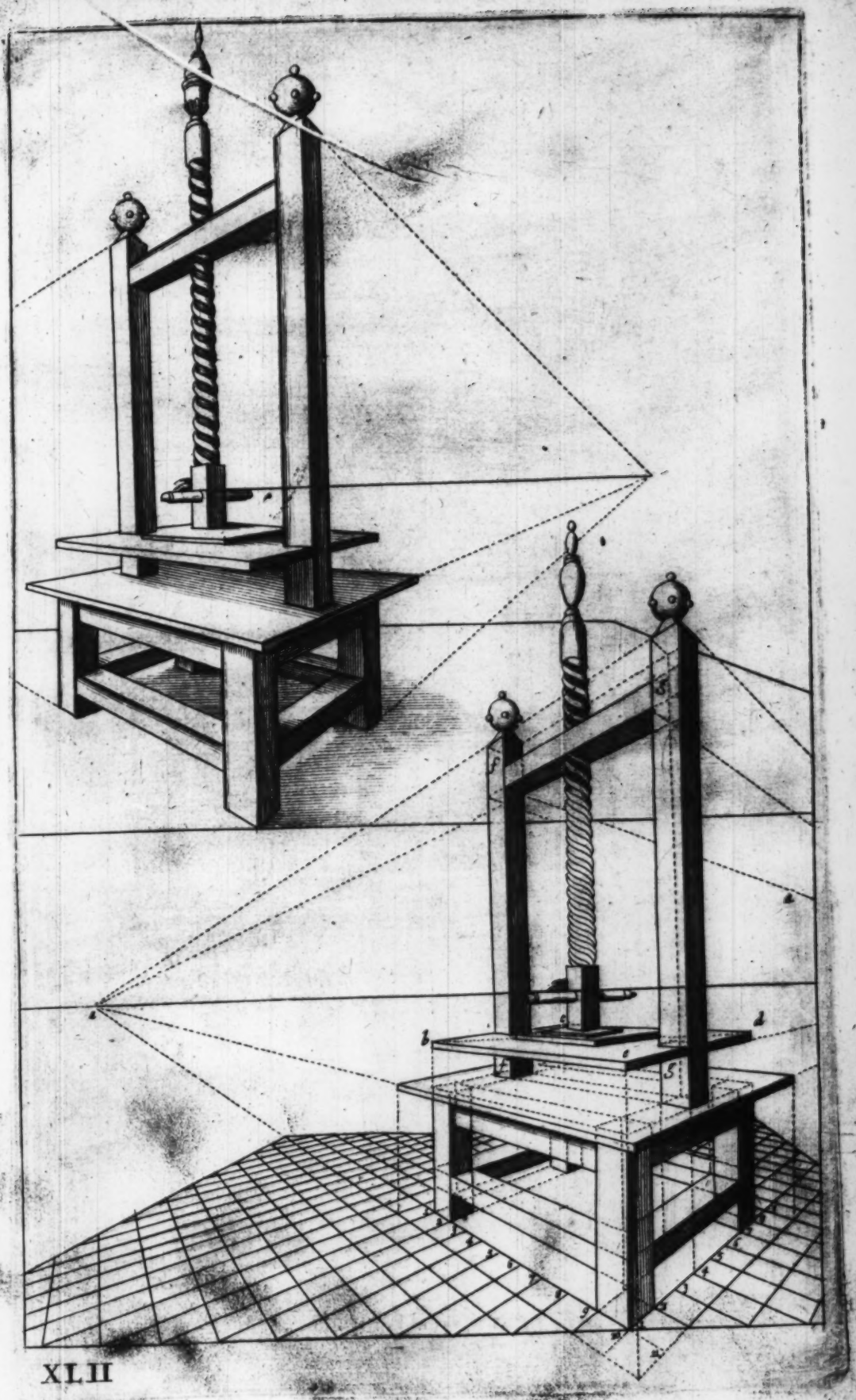

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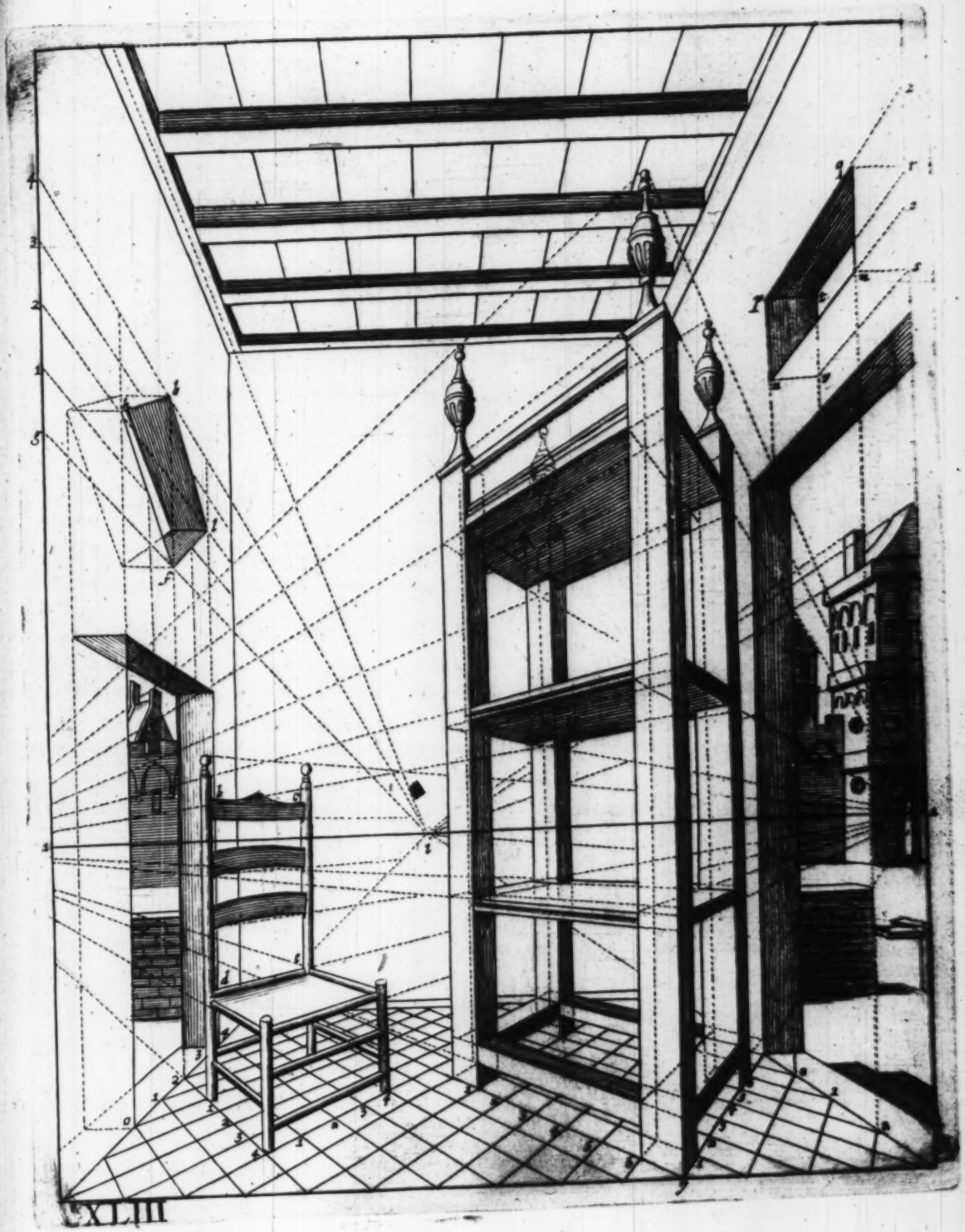

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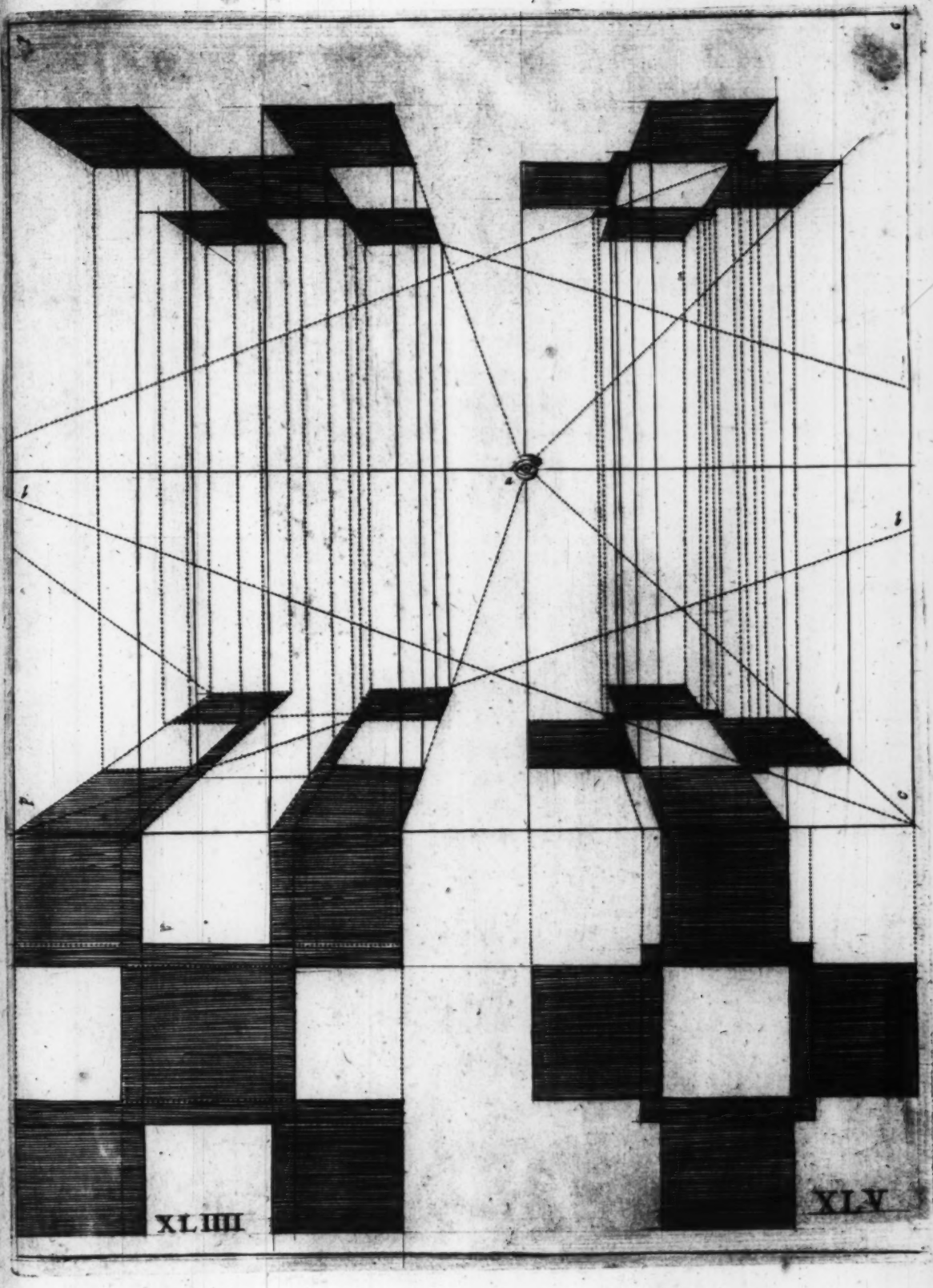
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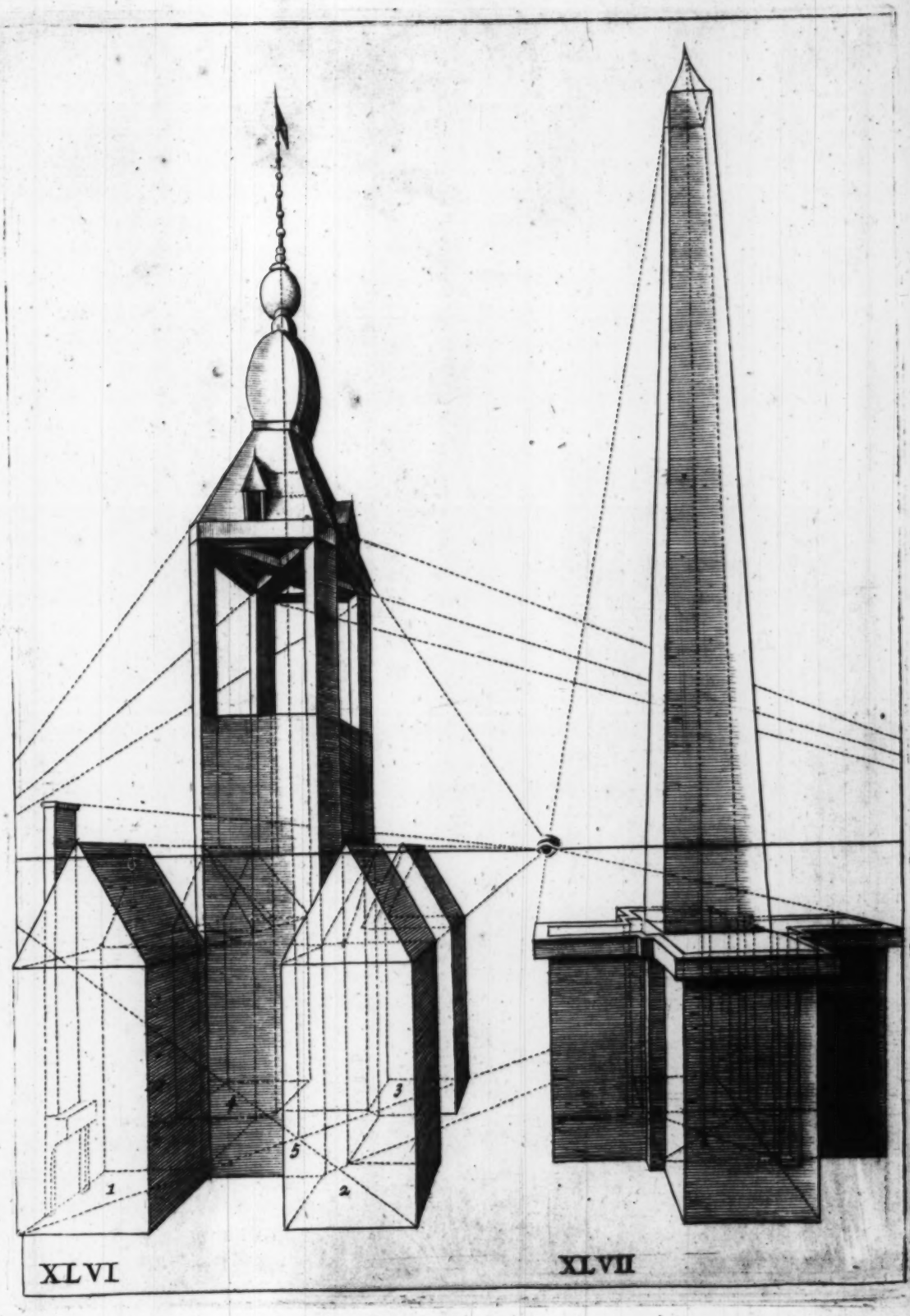


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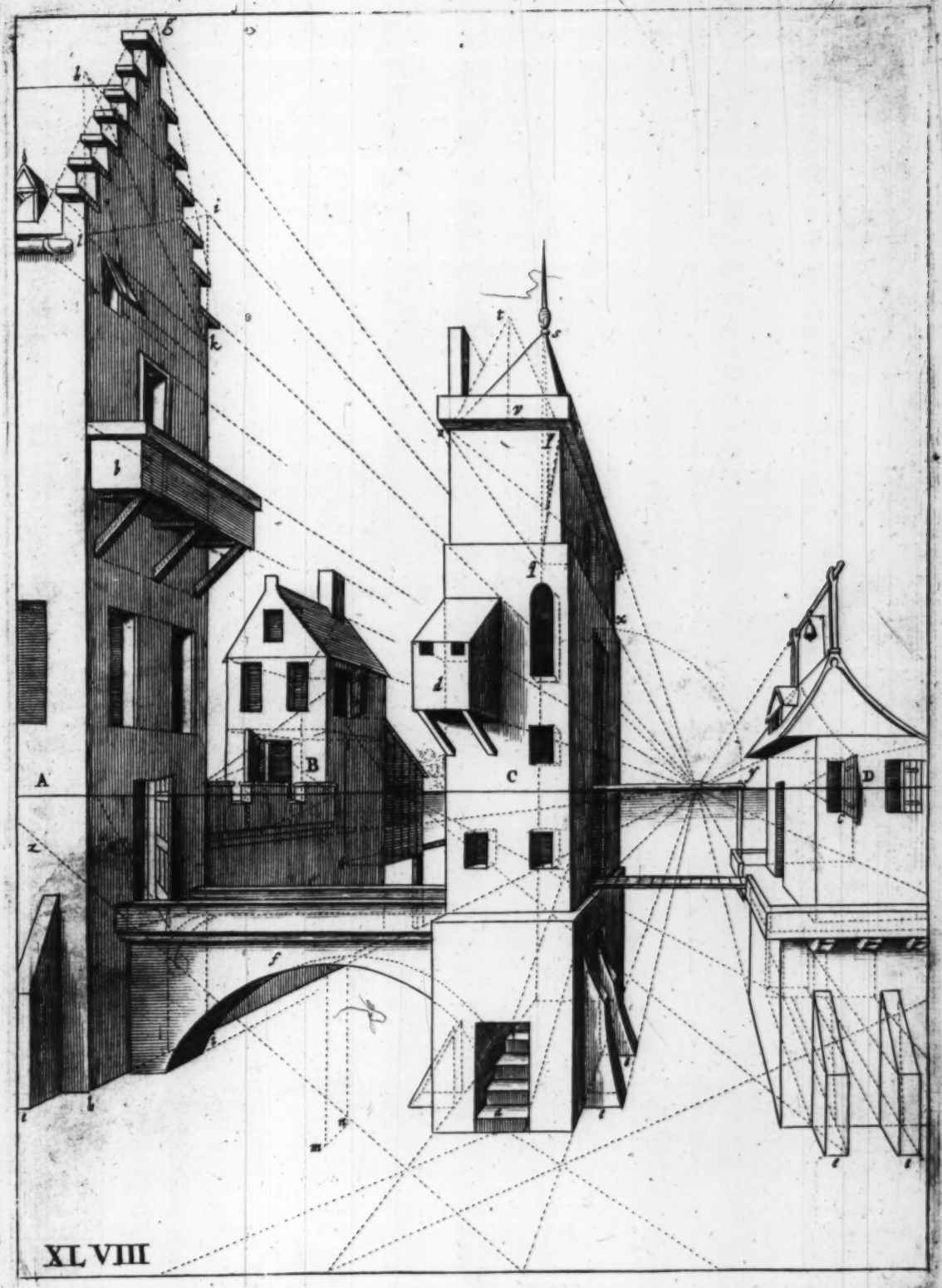
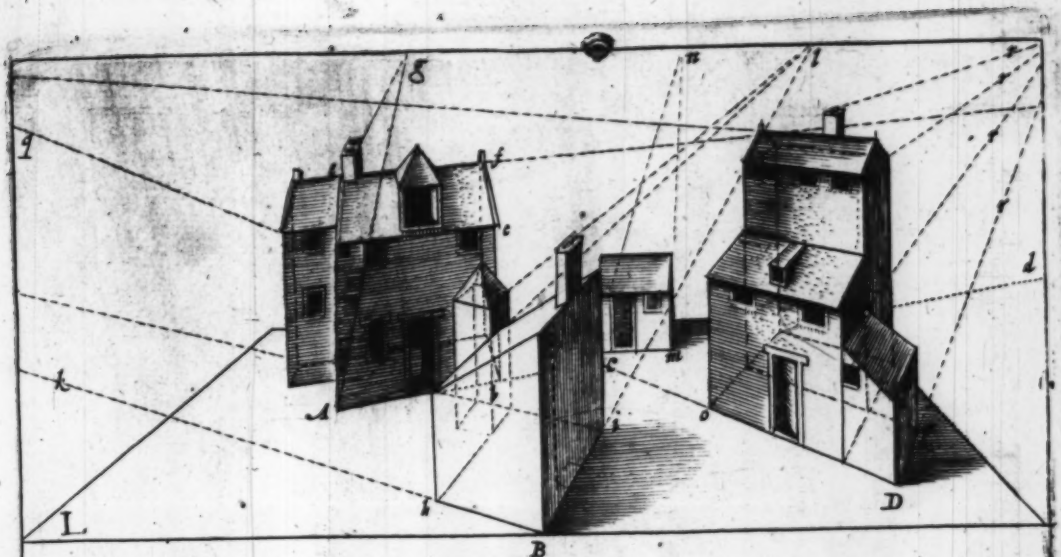



XL VIII

XLIX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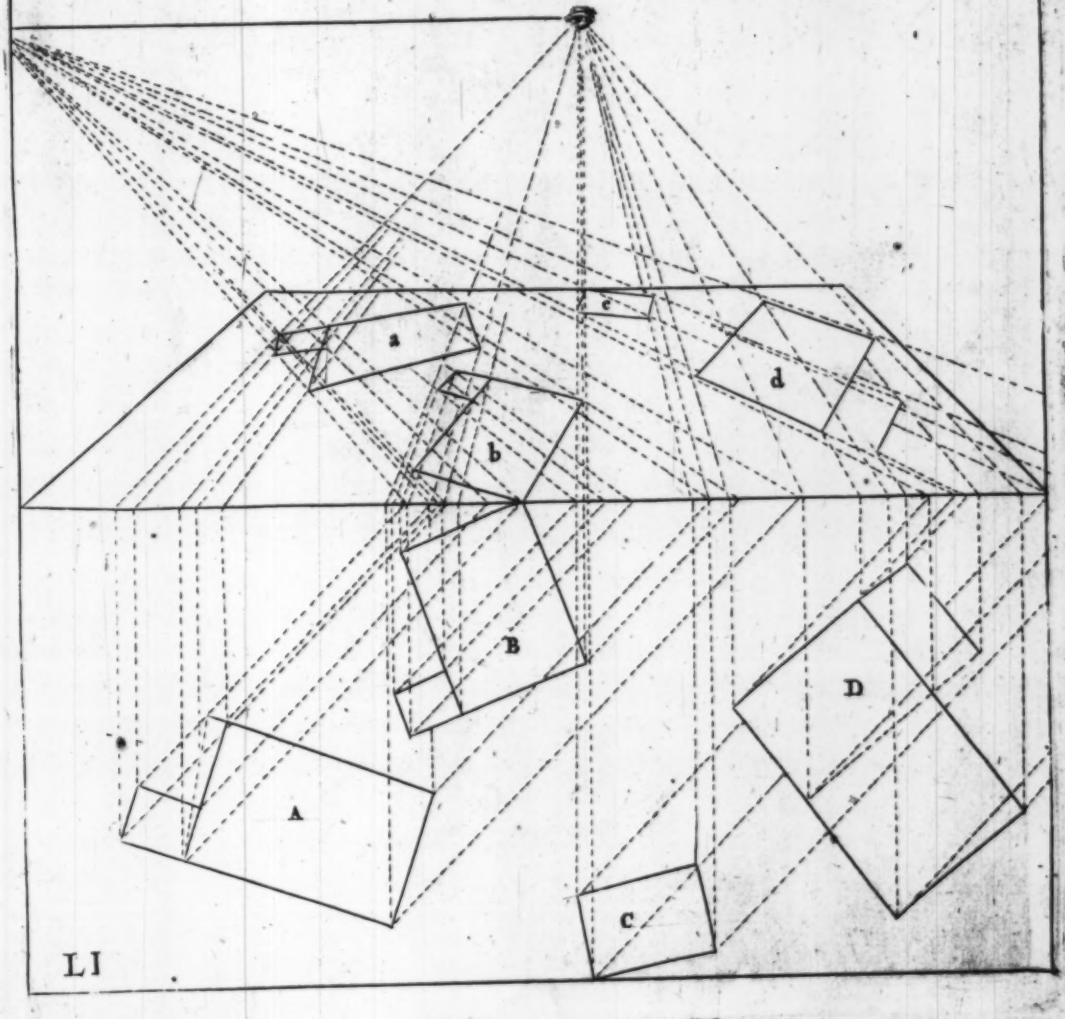
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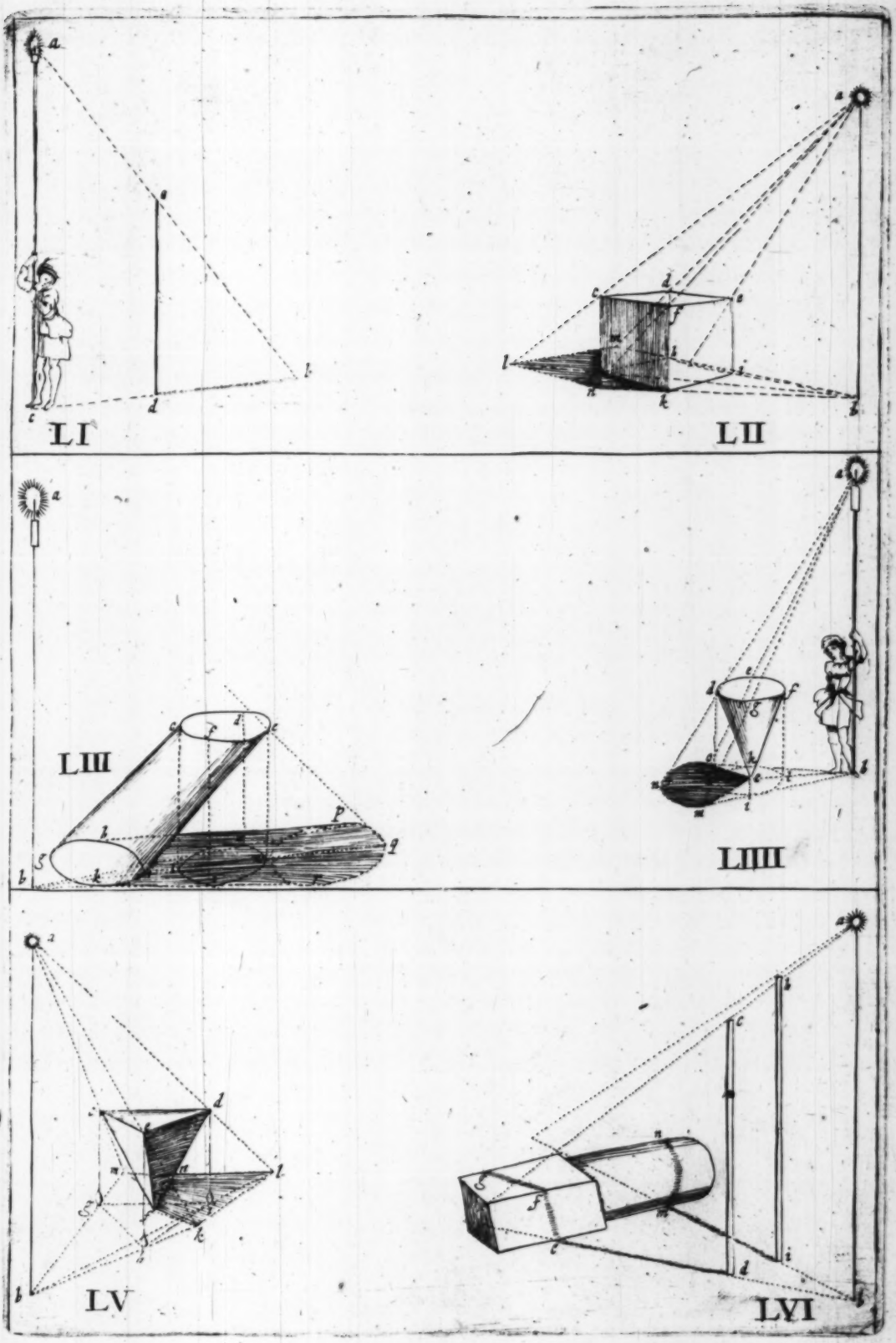
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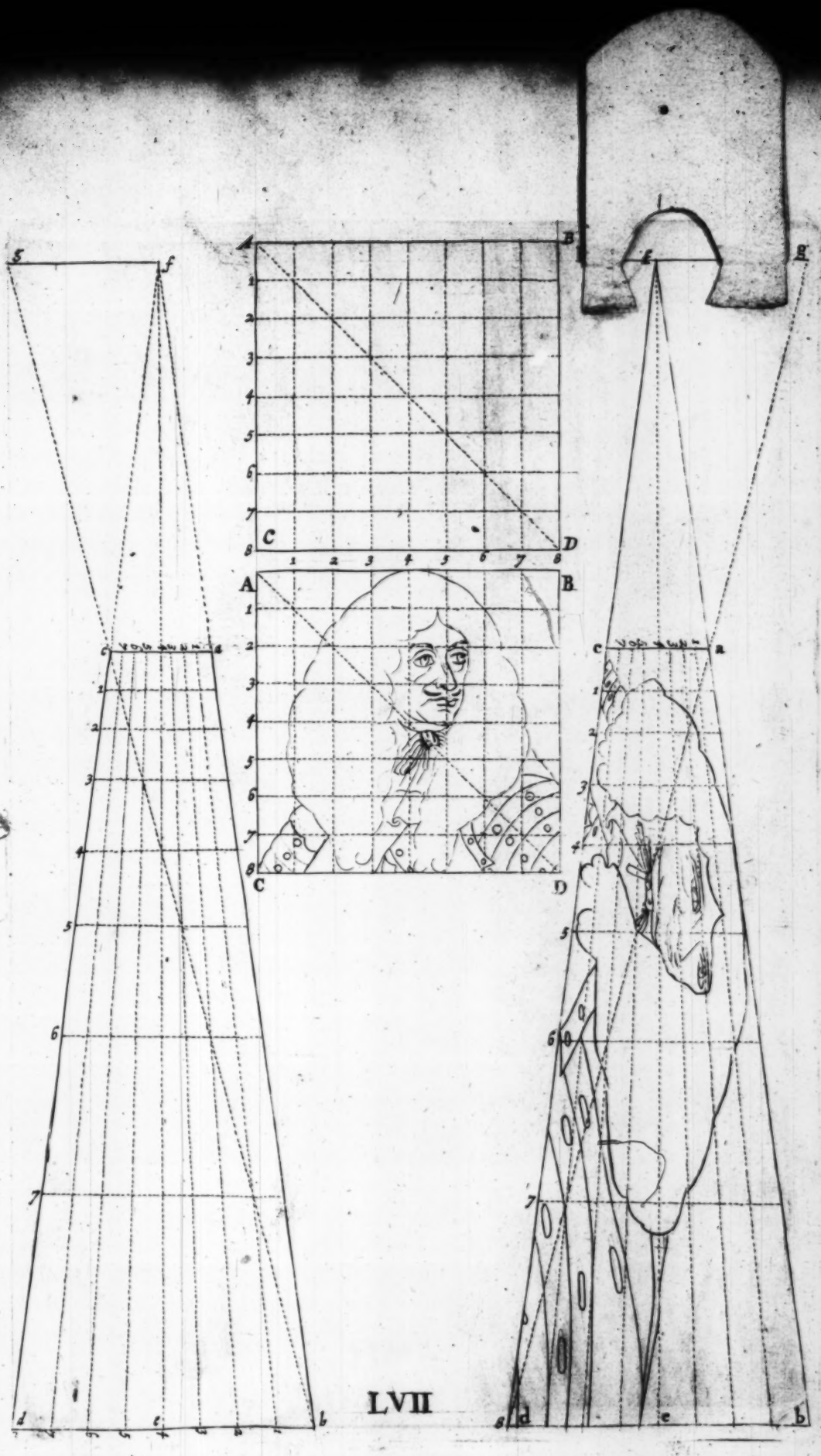


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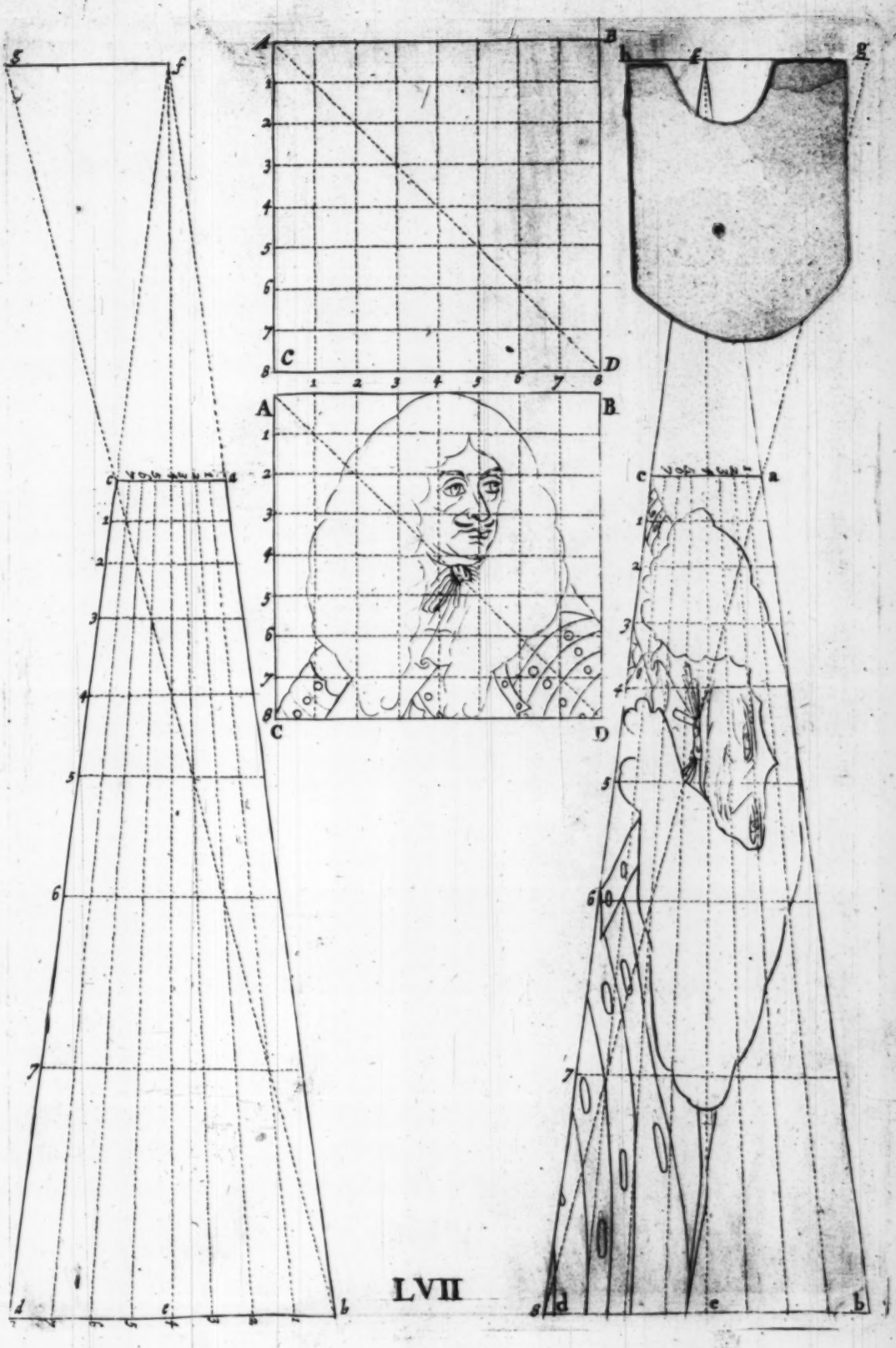


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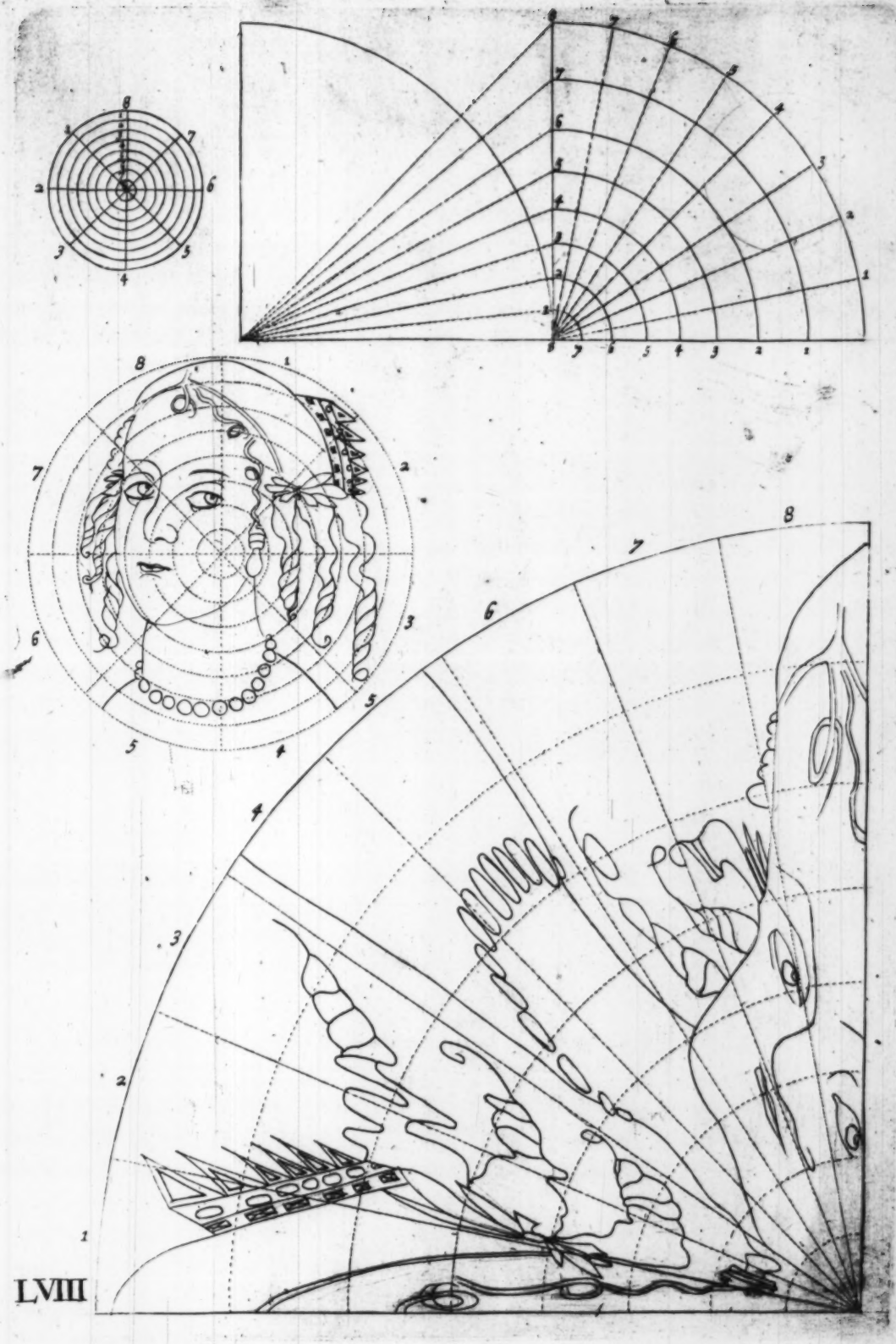

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